Birriwa Solar and Battery Project

Visual Impact Assessment

Prepared for ACEN Renewables Australia

February 2024

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ACEN Renewables Australia

J210553 Birriwa Solar and Battery Project - VIA

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Executive Summary

ES1 Introduction

ACEN Australia Pty Ltd, operating as ACEN Australia (ACEN) proposes to develop the Birriwa Solar and Battery Project; a large scale solar photovoltaic generation facility along with battery storage and associated infrastructure (the project). The solar project component of the project will have an indicative capacity of up to 600 megawatts (MW) and includes a centralised battery energy storage system of up to 600 MW and 2 hour duration. The project will be developed within a study area of approximately 1,300 hectares and will connect to the proposed Central-West Orana Renewable Energy Zone transmission link.

The project is in the localities of Birriwa and Merotherie, approximately 15 kilometres south-west of the township of Dunedoo, in the Central West of New South Wales (NSW). The project is within the Mid-Western Regional Council local government area (LGA), with part of the access route within the Warrumbungle Shire Council LGA, and is within the Central-West Orana Renewable Energy Zone.

This visual impact assessment (VIA) has been prepared to accompany a new State significant development application and environmental impact statement for the project. It has been prepared in accordance with the relevant Secretary's environmental assessment requirements (SEARs), guidelines and policies, and in consultation with the relevant government agencies.

ES2 Existing conditions

Much of the development footprint has been extensively cleared of trees and has been highly modified by historic farming practices. The landscape typical of the region is predominantly cleared, open grazing land with scattered groupings of remnant native trees. The existing vegetation is generally found along water courses, roadsides and along the perimeter of paddocks and property boundaries.

Most of the site falls from the lower slopes of Barneys Reef, which runs east to west along the southern boundary of the project. The elevation falls from 500 m (height above mean seal level) to approximately 420 m at the north-western corner of the study area. There are waterways running through the site from south to north toward the Talbragar River. These waterways have shaped the landscape creating low undulating hills and valleys across the landscape.

Residences and farm structures are dotted across the landscape. There are four associated residences within close proximity to the study area (A2, A4, A6 and A8). There are 21 non-associated residences within 2 km of the study area, many of them in the township of Birriwa, and another 22 between 2 km and 5 km away. At a closer scale, seven residences are within 200 m of the project study area, three of which are non-associated with the project (R1, R3 and R5).

The project sits 1.4 km east of the Castlereagh Highway, where the village of Birriwa is located. There is a low ridgeline between Birriwa and the project, which limits views into the proposed solar project. The Golden Highway runs east to west, some 4 km north of the project.

ES3 Assessment of impacts

The objective of a visual impact assessment is to determine how the proposed project will impact on the existing visual amenity and landscape character. Any potential negative impacts must be investigated to determine how it can be mitigated and reduced to an acceptable level.

The project design, development footprint and placement of the battery energy storge system (BESS) has evolved to minimise or avoid visual impacts where possible. This has included revisions to the PV array layout, the BESS locations and electrical infrastructure and associated grid connection point options for the project. Nonetheless, the development of the project will result in some changes to the landscape. Visual impacts will occur during the construction and operational stages of the project, and the visual landscape will be altered from its current state for the duration of the operation of the project.

Visual assessments have been conducted from a number of representative viewpoints surrounding the development footprint. The representative viewpoints were selected based on the following criteria:

- proximity to the project;
- the location of receptors (ie dwellings) and other local features/key locations (ie Birriwa village and the Central West Cycle Trail);
- the positioning of regional and local roads and potential impacts on passing motorists and cyclists;
- local topography; and
- presence of vegetation with potential to provide screening.

The representative viewpoints have been assessed to demonstrate the potential visual impacts of the project. The visual assessment determined that, of the viewpoints assessed, infrastructure may be visible to varying degrees from ten of the eleven viewpoints. Based on variable elevation and undulation in the landscape and the presence of vegetation, combined with the height of the solar arrays, the impact assessment predicts:

- a low visual impact from viewpoints 4, 5, 6,7, 8 and Birriwa village;
- a moderate visual impact from viewpoints 1, 2 (resident R3) and 3 as well as the Central West Cycle Trail; and
- there were no viewpoint locations with a high impact rating.

In addition to the viewpoint assessments, each resident within 2 km of the development footprint was assessed for visual impacts (Table 5.2 and Table 5.3). The assessment for residences predicts:

- a low visual impact from R1, R9, R10, R13, R14, R15, R16, R17, R18, R19, R20, R21, R22, R23;
- a moderate visual impact from R1a, R3, R5, R7, R11, R12; and
- no residences with a high impact rating.

Some mitigation measures are therefore proposed to reduce the visual impact at receptors, as described below.

ES4 Evaluation of the project

The two viewpoints with a moderate visual impact rating are from a residence and road located adjacent to the development footprint. It is also recognised that the development footprint is in close proximity to R3 (Viewpoint 2). The project design has therefore been revised to include a 300 m solar panel setback between the residence and the PV panels. In addition to the setback, a landscape screen is proposed along the property boundary at this location.

To mitigate and minimise the visual impact on R5, the project design was refined to include at least a 300 m buffer between the residence and the development footprint. Discussions between ACEN and the owners of R5 led to further setback with no proposed PV arrays within lot 12 on DP 750755 east of the residence, with the intention to remove any visible PV arrays within approximately 1 km of R5, to the satisfaction of the neighbours. Ongoing discussions between ACEN and the owner of R5 are taking place to evaluate the need for screen planting near the residence, as recommended in this assessment.

Other residences that have potential visual impacts include R7, R11 and R12. These are farther away from the development but may have views into the development footprint. Additional mitigation measures such as screen planting within the property may be considered in a separate agreement with the landholder.

Landscape screening is recommended to mitigate visual impacts at the following locations (refer to Landscape Plan, Figure 6.1):

- install screen planting (approximately 800 m) along the development footprint boundary at the north-west corner of the study area adjacent to Birriwa Bus Route North, to provide screening for R1 and R1a;
- install trees along the north side of Birriwa Bus Route South from Viewpoint 3 extending approximately 1 km; and
- install approximately 350 m of screen planting along the property boundary at R3.

The residual impact after the mitigation measures are applied reduces the visual impact in the following locations:

- Viewpoints 1, 2 (resident R3) and 3 (residence R5) as well as the Central West Cycle Trail reduced from moderate to low; and
- Residence R1a reduced from moderate to low.

ES4.1 Glint and glare

A glint and glare analysis was performed to measure the possibility of glare from the solar arrays and the project infrastructure (including potential BESS enclosures and sound walls). The results indicate that low levels of glare may be experienced along approximately 400 m of Birriwa Bus Route South (Central West Cycle Trail) for short periods during the winter.

The vertical walls of the BESS structures and sound walls, if the final detailed design of the project includes these structures (ie if they are required), will also reflect sunlight during the early morning and late afternoon, when the sun is low on the horizon. Most of this glare is predicted to occur along Birriwa Bus Route South (Central West Cycle Trail). There is, therefore, the potential to impact residences located east of the BESS locations as well as motorists and cyclists travelling west in the morning. It should be noted that there is only one residence east of the Option A location (R5) that may be affected, and one non-associated residence east of Option B location (R13) that may be affected.

In the evening in winter residences located west of the BESS will be similarly affected along with motorists and cyclists travelling east along Birriwa Bus Route South. The only non-associated residences west of the Option A location are along Castlereagh Highway and Birriwa Village, which are 2.9 km from the glare source. There is only one residence west of Option B location (R5) that may be affected.

It should be noted that this estimate is conservative because both Option A and Option B locations for the BESS structures have been included in the glare analysis. Further, the designs of the BESS infrastructure have yet to be finalised, and the analysis has been based on the [large shed-like enclosures], which is the most conservative assumption compared with the other more common cabinet or containerized solutions. With the refinement in the design of the BESS infrastructure and choice of location finalised, the amount of potential glare is expected to substantially decrease.

ES4.2 Night lighting

The only lighting proposed is for security and maintenance purposes. This will primarily occur at the substation and BESS compounds/buildings. The night lighting would be inwardly focused and shielded so it does not result in light spill impacts to nearby residences or the dark sky requirements.

The project will not impact on the Siding Spring Observatory provided the project lighting follows the Dark Sky Guidelines and AS 4282 Control of obtrusive effects of outdoor lighting.

Glint and glare from the project are not expected to impact on air traffic due to the distance from any aerodrome.

ES4.3 Cumulative impacts

Cumulative visual impacts can arise from the presence of similar projects can have a significant visual impact on the landscape when viewed together. Within a 25 km radius, there is one operational solar farm, two approved solar farms, three solar farms in the planning stage, one wind farm in the planning stage and one wind farm on exhibition.

Anticipated cumulative impacts are summarised below:

- Barneys Reef Wind Farm:
  - low visual impact for residents near the Birriwa Solar and Battery Project;
  - low visual impact for travellers along Castlereagh Highway and rail line; and
  - moderate visual impact for travellers along the Central West Cycle Trail (Merotherie Road and Birriwa Bus Route South).
- Valley of the Winds Wind Farm:
  - low visual impact for residents near the Birriwa Solar and Battery Project; and
  - low visual impact for travellers along the Golden Highway.

Definitions and abbreviations

Item	Definition
ABS	Australian Bureau of Statistics
AC	Alternating current
Access route	The route that will be used to access the project between the Castlereagh Highway and the access point to the site. The access route uses a section of Barneys Reef Road and a section of Birriwa Bus Route.
ACHA	Aboriginal cultural heritage assessment
AHIMS	Aboriginal Heritage Information Management System
Associated residence	A residence that is associated with the project – ie they have a landholder agreement with ACEN for the project. Residences identified with an 'A' are associated.
BESS	Battery energy storage system
CEEC	Critically endangered ecological community
CWO	Central-West Orana
DC	Direct current
Development footprint	Land within the study area that will be used for the operation of the project, which excludes certain areas of environmental or social constraint.
DPE	Department of Planning and Environment
DPI	Department of Primary Industries
EEC	Endangered ecological community
EIS	Environmental Impact Statement
EMM	EMM Consulting Pty Limited
EnergyCo	Energy Corporation of NSW
EP&A Act	NSW *Environmental Planning and Assessment Act 1979*
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
ha	hectares
km	kilometres
kV	kilovolt
LEP	Local Environmental Plan
LGA	Local government area
MNES	Matters of national environmental significance
MW	Megawatts
NO	CWO REZ Network Operator
Non-associated residence	A residence that is not associated with the project, with no landholder agreement with ACEN. Residences identified with an 'R' are non-associated.
NSW	New South Wales

Item	Definition
Operational infrastructure area	The proposed location of key operational infrastructure, including the BESS, substation, T-Link connection point, offices, car park, amenities and storage. Two locations are considered for the operational infrastructure area, but only one of the two location options will be implemented.
PCT	Plant community type
Study area	The boundary of the project in terms of lot boundaries, which encompasses all operational components of the project where ACEN hold landholder agreements. This land will be subject to the development consent. Note that public roads pass through the study area but are not part of the project or subject to landholder agreements.
PV	Photovoltaic
Restricted development area	Land within the development footprint where disturbance will be avoided wherever possible, with only specific nominated works permitted to occur.
REZ	Renewable Energy Zone
Road upgrade corridor	The area of direct impact for road upgrade construction along the access route.
SEARs	Secretary's Environmental Assessment Requirements
SIA	Social impact assessment
SSD	State significant development
Study area	The initial investigation area identified for preliminary environmental assessment, field survey and constraints analysis.
T-Link	Transmission link - NSW Energy Corporation's planned new 500/330 kV transmission line, substation(s) and related infrastructure within the CWO REZ.
TEC	Threatened ecological communities
The project	Birriwa Solar and Battery Project; a large scale solar photovoltaic generation facility along with battery storage and associated infrastructure. 'The project' refers to the project in its entirety; encompassing arrays of PV modules, power conversion units, BESS, connection infrastructure, road upgrades and ancillary infrastructure.
Viewpoint	Viewpoints are representative public and private viewpoints of the study area, which are selected for assessment of the project's level of exposure to them. They provide a representative sample of the likely visual landscape changes on the different users of the surrounding areas and their visual exposure to various project elements. Viewpoints can be representative of views from residential dwellings, public roadways or other local features (eg villages, other public recreation areas or scenic vistas of value to the community).
Viewshed	A viewshed is a theoretical assessment of visible elements from a particular viewpoint. It is created using GIS data (digital elevation model and digital surface model) to simulate the project's visibility from the selected viewpoints.
ACEN	ACEN Australia Pty Ltd

TABLE OF CONTENTS

Appendices

Tables

Figures

Plates

1 Introduction

1.1 Overview

ACEN Australia Pty Ltd, operating as ACEN Australia (ACEN) proposes to develop the Birriwa Solar and Battery Project; a large scale solar photovoltaic (PV) generation facility along with battery storage and associated infrastructure (the project). The solar project component of the project will have an indicative capacity of around 600 megawatts (MW) and include a centralised battery energy storage system (BESS) of up to 1,600 MW and two hour duration. The BESS will enable energy from solar to be stored and then released during times of demand.

The project is in the localities of Birriwa and Merotherie, approximately 15 kilometres (km) south-west of the township of Dunedoo, in the Central West of New South Wales (NSW) (refer to Figure 1.1). The project is within the Mid-Western Regional Council local government area (LGA) and is within the Central-West Orana (CWO) Renewable Energy Zone (REZ).

The project is a State significant development (SSD) under the *State Environmental Planning Policy (State and Regional Development) 2011*. Therefore, a development application for the project is required to be submitted under Part 4, Division 4.1 of the *NSW Environmental Planning and Assessment Act 1979* (EP&A Act). This visual impact assessment (VIA) report forms part of the Environmental Impact Statement (EIS).

1.2 Assessment approach and requirements

This VIA has been prepared in accordance with the relevant Secretary's environmental assessment requirements (SEARs), guidelines and policies, and in consultation with the relevant government agencies.

There are no Commonwealth, NSW or local government planning policies, guidelines or standards directly applicable to this assessment. The VIA was prepared with reference to the methods outlined in:

- *Draft Large-Scale Solar Energy Guideline* (2021) (the Draft Guideline), prepared by the NSW Department of Planning, Industry and Environment;
- *Guidelines for Landscape and Visual Impact Assessment Third Edition* (2013) (the GLVIA), prepared by the Landscape Institute and Institute of Environmental Management and Assessment; and
- *Wind Energy: Visual Assessment Bulletin AB 01 For State significant wind energy development* (2016) (the VA Bulletin) prepared by the NSW Department of Planning, Industry and Environment.

It is noted that the VA Bulletin specifically relates to assessment of visual impacts of wind farms in NSW; however, a number of the methods for describing visual sensitivity and landscape character are considered to be relevant to this assessment. In the absence of other directly applicable guidelines/standards, the relevant elements from the VA Bulletin have been adopted for this assessment.

The Draft Guideline was released by the NSW Government in 2021 and provides the community, industry, applicants and regulators with guidance on the planning framework for the assessment and approval of large-scale solar energy development proposals under the EP&A Act, which are classified as SSD.

The Draft Guideline also outlines a proposed visual assessment framework for large scale solar energy development. The acceptability of visual impacts, namely impacts on landscape character and values and the amenity of landholders and communities, along with the adequacy of the measures that are proposed to avoid, reduce or otherwise manage these impacts, are identified as key assessment issues within the draft guideline and have been considered in detail within this VIA.

The Draft Guideline also recommends consideration of cumulative impacts from other developments (proposed, approved and operating), including potential visual impacts where multiple solar developments may be constructed in close proximity to each other. Cumulative impacts of the project are discussed further in Section ES.4.

This VIA was prepared in accordance with the requirements of the NSW Department of Planning and Environment (DPE), which were set out in the SEARs for the project, issued on 1 October 2021. The SEARs identify matters that must be addressed in the EIS.

A copy of the revised SEARs is attached to the EIS as Appendix A, while Table 1.1 lists the individual requirements relevant to this VIA and where they are addressed in this report.

Table 1.1 Relevant SEARs

Requirement	Section addressed
Visual – including a detailed assessment of the likely visual impacts (including any glare, reflectivity and night lighting) of all components of the project (including arrays, transmission lines, substations and any other ancillary infrastructure) on surrounding residences and key locations, scenic or significant vistas, Central West Cycle Trail, Siding Spring Observatory in accordance with the *Dark Sky Planning Guideline* (2016), air traffic, road corridors in the public domain.	Chapter 5 Lighting measures in response to *Dark Sky Planning Guideline* in Chapter 6.
Visual – provide details of measures to mitigate and/or manage potential impacts (including a draft landscaping plan for on-site perimeter planting, with evidence it has been developed in consultation with affected landowners).	Chapter 6

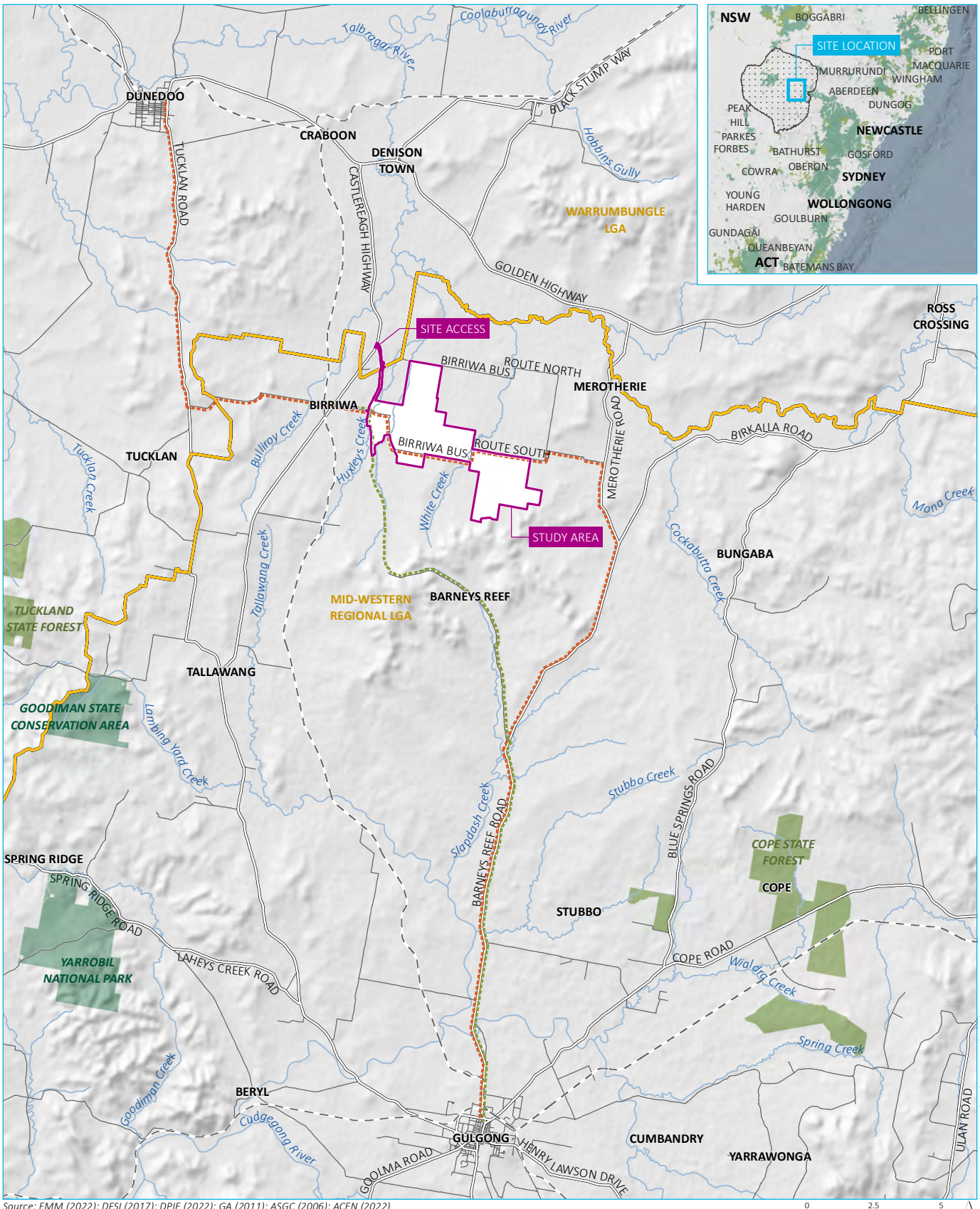
To inform preparation of the SEARs, DPE invited other government agencies to recommend matters to be addressed in the EIS. These matters were taken into account by the Secretary for DPE when preparing the SEARs. There were no comments regarding visual amenity from the agencies that have not been included in the SEARs.

1.3 Structure of the report

This report is structured as follows:

- Chapter 2 describes the project and the visual components of the project;
- Chapter 3 describes the VIA methodology adopted in the preparation of this report;
- Chapter 4 describes the existing landscape within which the project will be sited;
- Chapter 5 describes the impacts of the project from representative viewpoints in and around the project;
- Chapter 6 describes the mitigation measures proposed; and
- Chapter 7 provides conclusions.

A number of technical terms have been used throughout this report for the discussion of visual impacts. These are explained in the definitions and abbreviations.



Source: EMM (2022); DFSI (2017); DPIE (2022); GA (2011); ASGC (2006); ACEN (2022)

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GDA 1994 MGA Zone 55

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KEY

- Study area

Existing environment

- Rail line
- Major road
- Minor road
- Named watercourse
- Local government area
- Central West Orana Renewable Energy Zone (see inset)
- NPWS reserve
- State forest

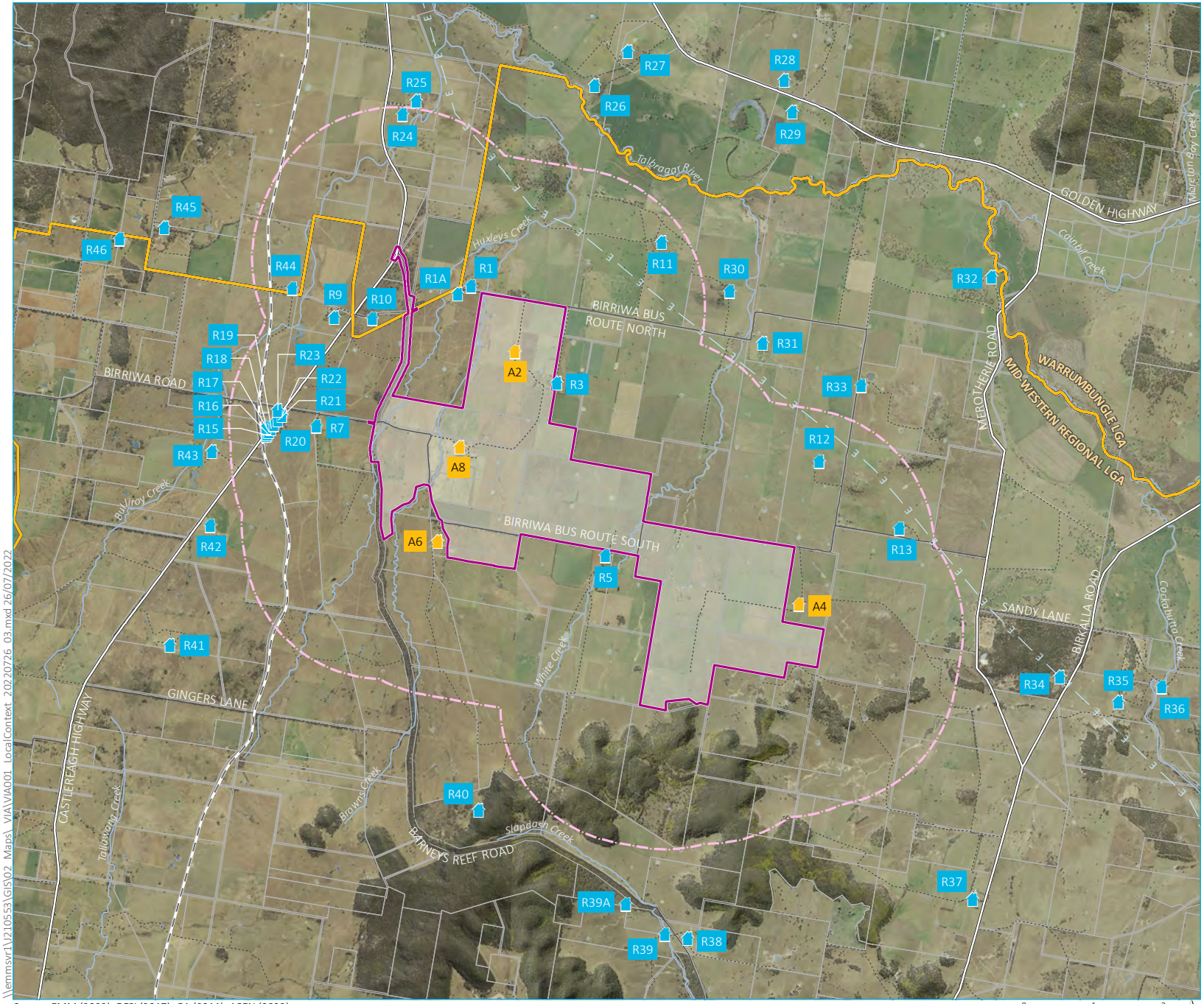
Central West Cycle (CWC) Trail

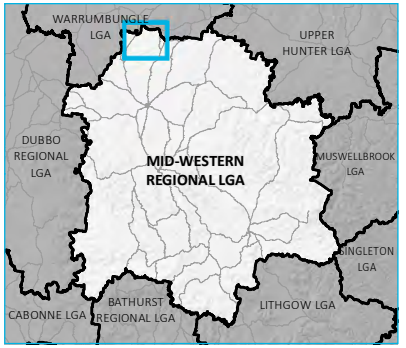
- CWC main route - Gulgong to Dunedoo
- CWC alternate route - Slap Dash Creek side trail

Regional context

Birriwa Solar and Battery Project
Visual impact assessment
Figure 1.1

EMM creating opportunities





KEY

- Study area
- Study area buffer (2 km)
- Dwelling associated with the project
- Dwelling not associated with the project
- Electricity transmission line (33 kV)
- Rail line
- Major road
- Minor road
- Vehicular track
- Named watercourse
- Cadastral boundary
- Waterbody
- Local government area

Source: EMM (2022); DFSI (2017); GA (2011); ACEN (2022)

0 1 2 km

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Local context

Birriwa Solar and Battery Project
Visual impact assessment
Figure 1.2

EMM creating opportunities

2 Project description

2.1 Overview

The project involves the development, construction and operation of a solar PV electricity generation facility and BESS, which consists of PV modules, batteries, inverters, transformers and associated infrastructure. A full project description is provided in Chapter 3 of the EIS. The project will comprise the following key components:

- development footprint, including:
  - PV modules and associated mounting infrastructure including tracking systems;
  - operational infrastructure area (including substation, BESS and ancillary infrastructure including an operations and control building);
  - electrical collection and conversion systems;
  - underground and aboveground cables;
  - parking and internal access roads;
  - security fencing; and
  - a temporary construction compound including laydown area;
- road upgrade corridor (ie area of direct impact for public road upgrade works); and
- construction footprint of public road crossings (ie area of direct impact for public road crossings).

The impact footprint (comprising the development footprint, road upgrade corridor, restricted development areas and construction footprint of public road crossings) are shown on Figure 2.1.

During the preparation of the EIS, the development footprint within the study area has been refined on the basis of environmental constraints identification, stakeholder engagement, community consultation and design of project infrastructure with the objective of developing an efficient project that avoids and minimises environmental and social impacts.

The project will connect to the proposed Merotherie Energy Hub via one of two indicative connection points. The exact location of the interface point between the project and the Merotherie Energy Hub is currently being defined in consultation with EnergyCo.

The development footprint will be accessed via the Castlereagh Highway, Barneys Reef Road and Birriwa Bus Route (Figure 2.1). From the project access point, private internal roads will be used to traverse the development footprint. A section of Barneys Reef Road and Birriwa Bus Route South will require upgrades to provide safe access to the development footprint during construction of the project.

2.2 Study area

The impact footprint sits within the study area and is the maximum extent of ground disturbing work associated with the construction and operation of the project. The impact footprint has been reduced in size from that originally considered in response to stakeholder engagement (with local residents), environmental assessment and constraints identification and comprises:

- the development footprint (area to be developed within land where ACEN hold landholder agreements and associated Crown Land such as public roads and 'paper' roads);
- road upgrade corridor (area of direct impact for public road upgrade works along the access route);
- construction footprint of public road crossings (area of direct impact for construction of public road crossings to allow construction and operational traffic and cable crossings between different land parcels); and
- restricted development areas include land within the development footprint where disturbance will be avoided, wherever possible, with the exception of that required for the provision of fencing, access and electrical reticulation (ie private internal access rods and electrical cables).

As described in Section 2.5 of the EIS, a number of alternative arrangements have also been considered throughout the project refinement process for the placement of internal access roads, as well as the proposed footprints for substation and BESS infrastructure. ACEN has adopted a flexible approach to design for this infrastructure to ensure that the final location can respond to identified social and environmental impacts and constraints.

2.3 Physical layout and design

2.3.1 Project components

i PV modules

The project will involve the installation of rows of PV modules (solar panels) mounted on trackers, with multiple rows making up 'power blocks' or 'arrays' that are connected into a power conversion unit (PCU). The exact number of PV modules and the final configuration will not be determined until the detailed design stage after development approval is granted; however, based on a 600 MW (AC) facility, it is anticipated that there will be approximately 1 to 1.4 million PV modules.

The final electricity generation capacity will also be determined separately through formal consultation with EnergyCo, the CWO REZ Network Operator (to be appointed at the time of lodgement of this VIA) and the Australian Energy Market Operator in a distinct connection study and tendering processes, which will be subject to the capacity limits of the CWO REZ T-Link and hence should not be fixed. Regardless, all PV modules will be contained within the development footprint.

The project involves the use of a single axis tracking system. An example of the type of PV modules mounted on a single axis tracking system that may be used is provided in Plate 2.1. The PV modules will be installed on racking frames fixed onto a horizontal tracker tube, with this mounted on top of vertical piles driven or screwed into the ground. The PV modules will be installed in rows generally spaced between 8 m and 12 m apart depending on the tracking system selected, the configuration of the panels on the trackers and the final design. The rows of PV modules will be aligned in a north-south direction, allowing the panels to rotate from east to west during the day, tracking the sun's movement.

The PV modules will be generally up to 1.2 m from the ground when in the horizontal position, while the lower edge of each PV module will be no less than 0.3 m from the ground or above the flood level at the maximum tilt angle. The maximum height of the panels to the higher edge from ground level at the maximum tilt angle is expected to be 4.7 m, which is assuming a '2 in portrait' (2P) configuration (ie worst case). Examples of '1 in portrait' (1P) and 2P configurations are shown in Plate 2.1 and Plate 2.2. This may vary locally in areas of higher flood hazard where freeboard is required to be greater than 0.3 m from the ground, total height can be higher than 4.7 m at some very specific locations.

DC cables will be strung underneath the PV modules, housed in cable trays, or be passed through the tracker tubes before being connected to the PCUs.

Plate 2.1 Example of a PV module layout (2 in portrait or 2P configuration)

Source: NexTracker (2018)

Plate 2.2 Example of a PV module layout (1 in portrait or 1P configuration)

Source: NexTracker (2018)

ii Power conversion units

The PCUs comprise three main components (inverters, transformers and a ring main unit) and are designed to convert the DC electricity generated by the PV modules into AC form, which is compatible with the national electricity grid. The PCUs will also increase the voltage of the electricity from 11 kV, generated by the PV modules, to 33 kV for transmission to the substation via medium voltage cables buried underground.

The exact dimensions and configuration of the PCUs will be determined during detailed design and the original equipment manufacturers (OEMs) active in the market are constantly developing new products with slightly different MW capacities, designs and dimensions. The PCUs are typically either containerised (20 ft or 40 ft shipping containers) or a skid-mounted or "outdoor" design, which is with the cabinets and transformers mounted on either a steel platform or a thin concrete pad. An example of what the PCUs may look like within the development footprint is provided in Plate 2.3. This example, which might be deployed but has not been chosen and is provided for illustrative purposes only, is an outdoor design mounted on a steel skid, and the dimensions are approximately 8 m in length by 2.6 m wide by 2.7 m high. The exact manufacturer and model to be used will be determined as part of the grid connection studies and the detailed design and procurement phase.

The quantity of PCUs required will be determined during detailed design; however, based on a 600 MW facility it is anticipated that approximately 80–160 PCUs will be required, depending on the final design and procurement decisions made at the time of construction.

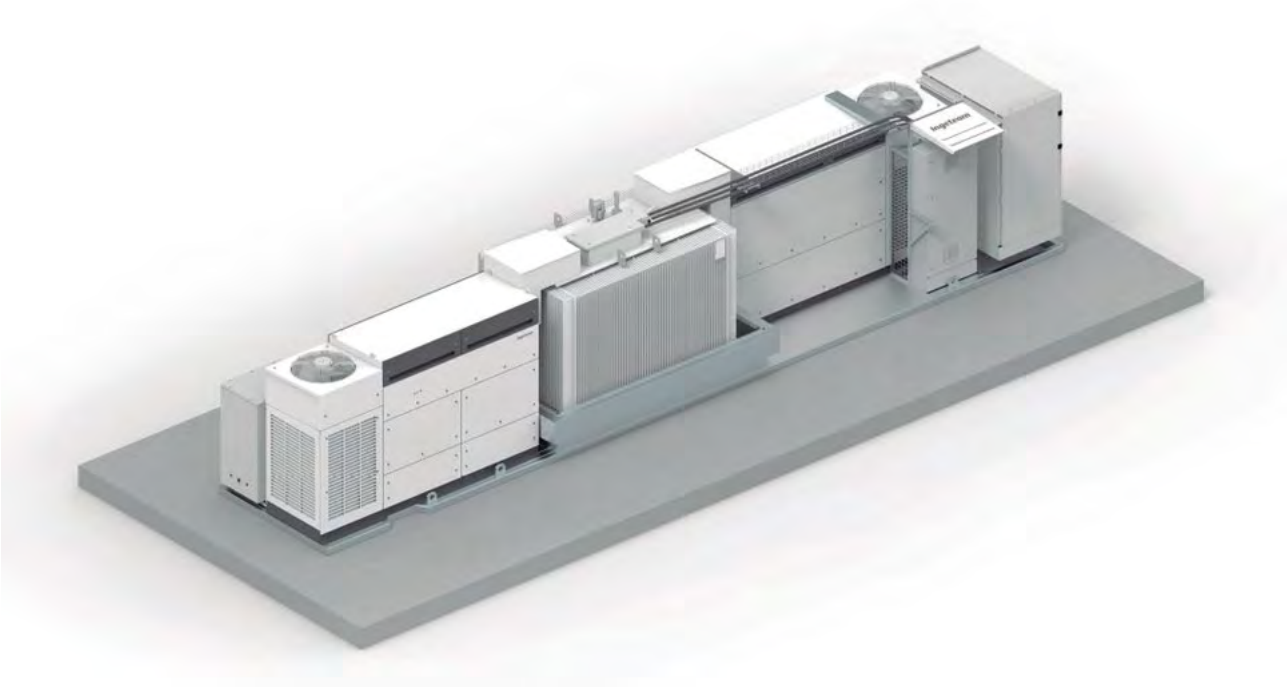


Plate 2.3 Example of a PCU mounted on a galvanised steel skid

Source: Ingeteam

iii Electrical reticulation cable

A medium voltage (MV) cable reticulation network will be required to transport the electricity around the PV module arrays. If underground, cables of either 11 kV, 22 kV or 33 kV will be installed at a depth of at least 600 millimetres (mm) and will be designed and fitted in accordance with relevant Australian industry standards. Electricity from the MV cable network will be stepped up to high voltage (HV) at the grid connection substation.

Overhead transmission lines may also be required to transport electricity. The alignment of the overhead transmission lines and design, height and style of the structures required to support them will be determined during the detailed design stage of the project, and in some circumstances in consultation with the CWO REZ Network Operator (NO) and EnergyCo for any potential REZ Network Infrastructure (RNI). The easement and distance between each structure required for the overhead transmission lines will be dependent on the type of structure selected.

iv Substation and BESS infrastructure area

An area where the collector substation, switchgear and BESS infrastructure will be installed/constructed will be chosen at one of two location options A or B within the development footprint. Other infrastructure associated with the operation and the maintenance of the project will be located within the preferred location option: this includes the O&M building, workshop and spare parts building and any potential CWO RNI in consultation with EnergyCo and the REZ NO.

a Battery energy storage system

The purpose of the BESS will be to support the network, introduce a dispatchable capability to the project's energy generation profile and allow for revenue diversification. It will also enable the facility to participate in the frequency control and ancillary services (FCAS) markets and a capacity market, if introduced at a NEM wide level.

The project will include a centralised BESS of up to 600 MW for 2 hour duration. The final technology, MW rated capacity and storage of the proposed BESS will be determined during the detailed design stage of the project and will be dependent on a number of commercial and financial considerations. The sizing of the BESS is also likely to be driven by government policy given the current focus on mechanisms to ensure reliability and dispatchability of renewable energy power generation.

The BESS will be adjacent to one or more substations within the development footprint and will be housed within either a number of small enclosures/cabinets, shipping containers or larger battery buildings. The specific design details for the BESS and their respective enclosure types will be confirmed at detailed design stage prior to construction.

Each of the substation and BESS infrastructure areas presented in Figure 2.1 provide adequate flexibility for design and siting of the applicable BESS at each location. Indicative footprint sizes and infrastructure heights for the potential BESS structures are summarised in Table 2.1. These dimensions should be considered indicative only. Exact dimensions will be refined during the detailed design stage of the project.

Table 2.1 Comparison of BESS design options

BESS design	Indicative footprint	Height of dominant infrastructure	Maximum height of infrastructure
Outdoor standalone rack	8.6 ha	3.8 m	7.5 m building 25 m (lightning protection)
Containerised	9.5 ha	3.8 m	
Dedicated use building	9.4 ha	7.5 m	

Note: the 'Indicative footprint' was assessed on the basis of a 1 GW/1 hour BESS. The proposed BESS was reduced to 600 MW capacity system/2 hour duration during the preparation of the EIS, which has a similar footprint.

The major components for each BESS include:

- Batteries – the specific battery module manufacturer and model has not been selected; however, it will likely be a type of lithium ion battery.
- Inverters – convert the DC electricity generated by the PV modules into AC – ACEN may be considering the use of grid-forming inverters, which would enable the project to enhance the stability of the transmission grid.
- Transformers – the configuration of the transformers will be subject to the type of batteries used and the BESS configuration.
- Heating ventilation air conditioning (HVACs) – one of three types of HVAC will likely be used as part of the BESS to maintain the batteries at a temperature that will optimise their lifetime and performance. This includes small package units; large chillers or a liquid cooling system (should the battery cabinet configuration be installed).
- Fire protection – active gas-based fire protection systems will be installed within the BESS enclosure. Thermal sensors and smoke/gas detectors will be installed and connected to a fire control panel.

The components described above will be similar for each of the BESS structures likely to be constructed as part of the project. As noted above, the specific design details for the BESS will be confirmed at detailed design stage of the project.

b Substation

Electricity from the medium voltage electrical reticulation cable network will be increased to high voltage electricity at the substation, to match the voltage of the network at the connection point. The substation will sit within one of the two nominated operational infrastructure areas.

The substation will consist of an indoor switch room to house the medium voltage switchboard and circuit breakers, and an outdoor switch yard to house the transformer(s), gantries and associated infrastructure. A security fence will be installed around the substation to maintain project security and public safety.

From the substation, electricity generated by the project will be injected into the grid at the development footprint boundary via one of two indicative connection points. The exact location of the interface point between the project and the Merotherie Energy Hub is being defined in consultation with EnergyCo.

Potential REZ Network Infrastructure (RNI) may be co-located with the project substation, eg transmission line to the Merotherie Energy Hub.

c Ancillary infrastructure

In addition to the BESS and substation, the substation and BESS infrastructure area will house:

- a workshop and associated infrastructure;
- a temperature-controlled spare parts storage facility; and
- staff office, operations and control room, meeting facilities, amenities and carparking.

v Supporting infrastructure

In addition to the infrastructure described above, the project will also require:

- a number of new internal roads to facilitate access within the development footprint to allow for construction and ongoing maintenance; and
- fencing and landscaping.

Chain-link (or mesh) security fencing will be installed within the study area to a height of up to 2.4 m high. The specific location of the security fencing will be determined in consultation with the contractors selected for the construction of the project and project landholders. Fencing will restrict public access to the development footprint. Where possible, fencing will be positioned to minimise disruption to ongoing agricultural operations on land adjacent to the development footprint.

2.3.2 Project access

i Access

The primary vehicle access route will be via the Castlereagh Highway, Barneys Reef Road and Birriwa Bus Route South. The primary project access point on Birriwa Bus Route South will provide access to the development footprint. These access roads will be upgraded as described in Section 3.3.2 of the EIS.

Internal access roads will be constructed to facilitate access to the remainder of the development footprint; however, up to three public road crossings will be constructed to allow project-related vehicles to move across public road corridors and between parcels of land that form part of the development footprint. These crossings will reduce the impact of project-related vehicles on the local road network and maximise the use of the project's internal road network during construction and operations.

In addition, waterway crossings will be required to facilitate vehicle movements within the development footprint. Waterway crossings are proposed within the restricted development area; however, their exact location will be determined during detailed design. It is assumed that each crossing will require a disturbance corridor of up to 40 m wide (including road and cable corridors). All waterway crossings will comply with the *Policy and Guidelines for Fish Friendly Waterway Crossings* (DPI 2003) and *Guidelines for Watercourse Crossings on Waterfront Land* (DPI 2012).

2.4 Uses and activities

2.4.1 Construction

i Staging

The construction of the project will generally include the following overlapping stages:

- public road upgrades including public road crossings (pre-construction);
- site establishment including security fencing;
- construction (including temporary construction ancillary facilities);
- BESS and substation installation; and
- commissioning and testing.

ii Site preparation

Site establishment works and preparation for construction may include:

- the establishment of a temporary construction site compound in a fenced-off area within the development footprint including:
  - a project office;
  - containers for storage;
  - workshops;
  - parking areas;
  - workforce amenities; and
  - temporary laydown areas;
- construction of access tracks and installation of boundary fencing;
- site survey to confirm infrastructure positioning and placement;
- ongoing geotechnical investigations to confirm the ground conditions;
- preliminary earthworks and installation of environmental controls including erosion and sediment management structures; and
- identification and demarcation of no-go zones around trees and vegetation to be retained.

As part of site establishment works, management measures will be implemented to mitigate potential impacts on the environment and receptors within close proximity of the development footprint. Where required, additional or improved drainage channels, sediment control ponds and dust control measures will be implemented. Further, laydown areas and waste handling, fuel and chemical storage areas will be strategically placed to minimise potential environmental impacts during the construction stage of the project.

Earthworks will be limited to the locations requiring resurfacing activities for temporary construction facilities (including laydown areas, construction compounds and carparking areas) and permanent operational infrastructure such as the substation, BESS and ancillary infrastructure. A small level pad area may need to be prepared for the PCUs depending on which specific solution is chosen in detailed design.

Minor earthworks will also be required to prepare the development footprint for the installation of the rows of PV modules including some grading or levelling where required. The need for heavy earthworks such as grading/levelling and compaction will be minimised as much as practicable.

The extent of excavations and volume of fill required for the project will depend on geotechnical conditions and the final locations for infrastructure and will be determined during detailed design of the project.

iii Activities

Upon completion of the site establishment and pre-construction activities described above, construction activities will typically be rolled out as follows:

- installation of steel piles and mounting system for the tracking system and PV modules;
- secure PV modules to mounting system;
- trenching and installation of DC cabling, medium voltage and high voltage cables;
- installation of PCUs, either on steel skids, concrete pads or in modified shipping containers;
- construction of permanent site office, operations and control room, meeting facilities and amenities, spare parts storage facility, SCADA facilities and workshop;
- construction of the on-site substation (including grid connection related infrastructure);
- establishment of the BESS compound;
- test and commission project infrastructure; and
- removal of temporary construction facilities.

iv Plant and equipment

The plant and equipment required for the construction of the project will include:

- earthmoving machinery and equipment for site preparation;
- cable trenching and laying equipment;
- pile-driving equipment;
- assisted material handling equipment (forklifts and cranes);
- machinery and equipment for connection infrastructure establishment and installation of the BESS; and
- water trucks for dust suppression.

v Delivery of construction material and infrastructure

Construction materials and infrastructure will be transported to the development footprint via road. Heavy vehicles up to 26 m in length and over-dimensional vehicles will require access to the development footprint.

vi Construction duration

The construction phase of the project is expected to take up to 28 months from the commencement of site establishment works, including completion of the substation and grid connection works.

Construction activities will be undertaken during standard daytime construction hours consistent with the *Interim Construction Noise Guideline* (ICNG) (DECC 2009).

2.4.2 Operations

The operational lifespan of the project will be in the order 30 years unless the solar project is re-powered at the end of the PV modules' technical life. The decision to re-power the solar project will depend on the economics of solar PV technology and energy market conditions at that time. Should the PV modules be replaced during operations, the lifespan of the project may extend to up to 50 years. The BESS's operating life is likely to be 20 years, with the potential for replacing components to extend its life if the market conditions warrant this. Throughout operations a workforce of up to 20 FTEs will be required.

i Activities

It is anticipated that the facility will require regular maintenance throughout its operational life. This will include the following ongoing tasks:

- site maintenance including:
  - vegetation maintenance;
  - weed and pest management;
  - fence and access road management;
  - upgrading drainage channels; and
  - landscaping;
- infrastructure maintenance including:
  - PV module cleaning;
  - PV module, PCU and tracker system repair (if required);
  - inverter and PCU replacement (within every 7–10 years); and
  - equipment, cabling, substation and communications system inspection and maintenance.

ACEN is currently in discussions with a number of the host landholders to enable sheep grazing to resume on portions of development footprint following the completion of the construction of the project. A detailed protocol will be developed to ensure biosecurity is maintained and that grazing does not impact on the safe and efficient operation of the project or result in injury to farm workers, stock or operations staff.

To ensure the optimal electricity production output for the project is maintained, the PV modules may need to be washed periodically to remove dirt, dust and other matter. Water for panel cleaning will be transported to site via water trucks. Washing will not require any detergent or cleaning agents.

The operational workforce will also be responsible for ongoing security monitoring of project infrastructure. Perimeter security cameras may be utilised to assist with monitoring.

ii Transport route and vehicle movements

Regular light vehicle access will be required throughout operations; however, is not anticipated to exceed approximately 20 light vehicles per day. Heavy vehicles may be required occasionally for replacing larger components of project infrastructure including inverters, transformers or components of the BESS.

2.4.3 Decommissioning

Once the project reaches the end of its investment and operational life, the project infrastructure will be decommissioned and the development footprint returned to its pre-existing land use, namely suitable for grazing or cropping, or another land use as agreed by the project owner and the landholder at that time.

Project decommissioning will require disturbance of the development footprint during the removal of equipment. A significant number of people, including both staff and contractors, and vehicle movements will be required during the decommissioning stage of the project.

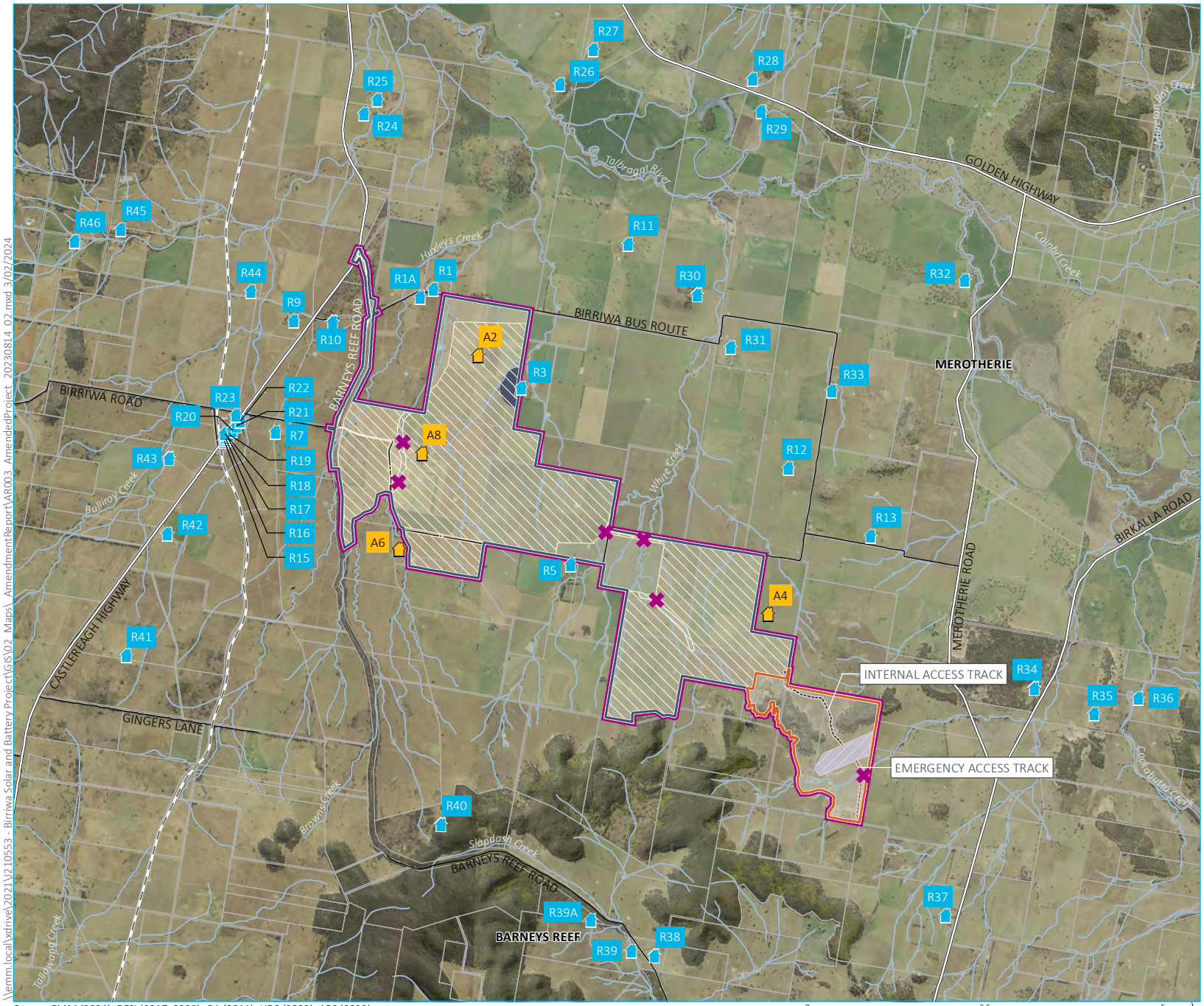
Any underground cabling below 600 mm will remain in-situ following project decommissioning unless agreed otherwise with the landholders.

ACEN will attempt to recycle all dismantled and decommissioned infrastructure and equipment, where possible. Structures and equipment that cannot be recycled will be disposed of at an approved waste management facility.

2.5 Mitigation of visual impacts

Development of the project design has included measures to reduce the visual impacts on the neighbouring residences. In response to community feedback the project footprint has been modified to move the nearest infrastructure away from impacted residents as much as possible. These changes and others are outlined on Figure 2.3, and include:

- A buffer area has been included in the project design around neighbouring residences. A 300 m buffer has been included in the design around these residences where no project infrastructure (including solar panels) will be installed. Residences with the buffer include R5, which is a non-associated residence close to the development footprint with a buffer. Additionally, Lot 12 (directly east of R5) will not have PV arrays installed on it.
- A 300 m solar panel setback has been included at R3 between the residence and the PV panels. In addition to the setback, a landscape screen is proposed along the property boundary at this location.
- The substation and BESS areas have been selected for their minimal visual impact within the development footprint, as far as possible non-associated residents.
- Existing vegetation such as rows of trees will generally be retained along water courses and public roads.



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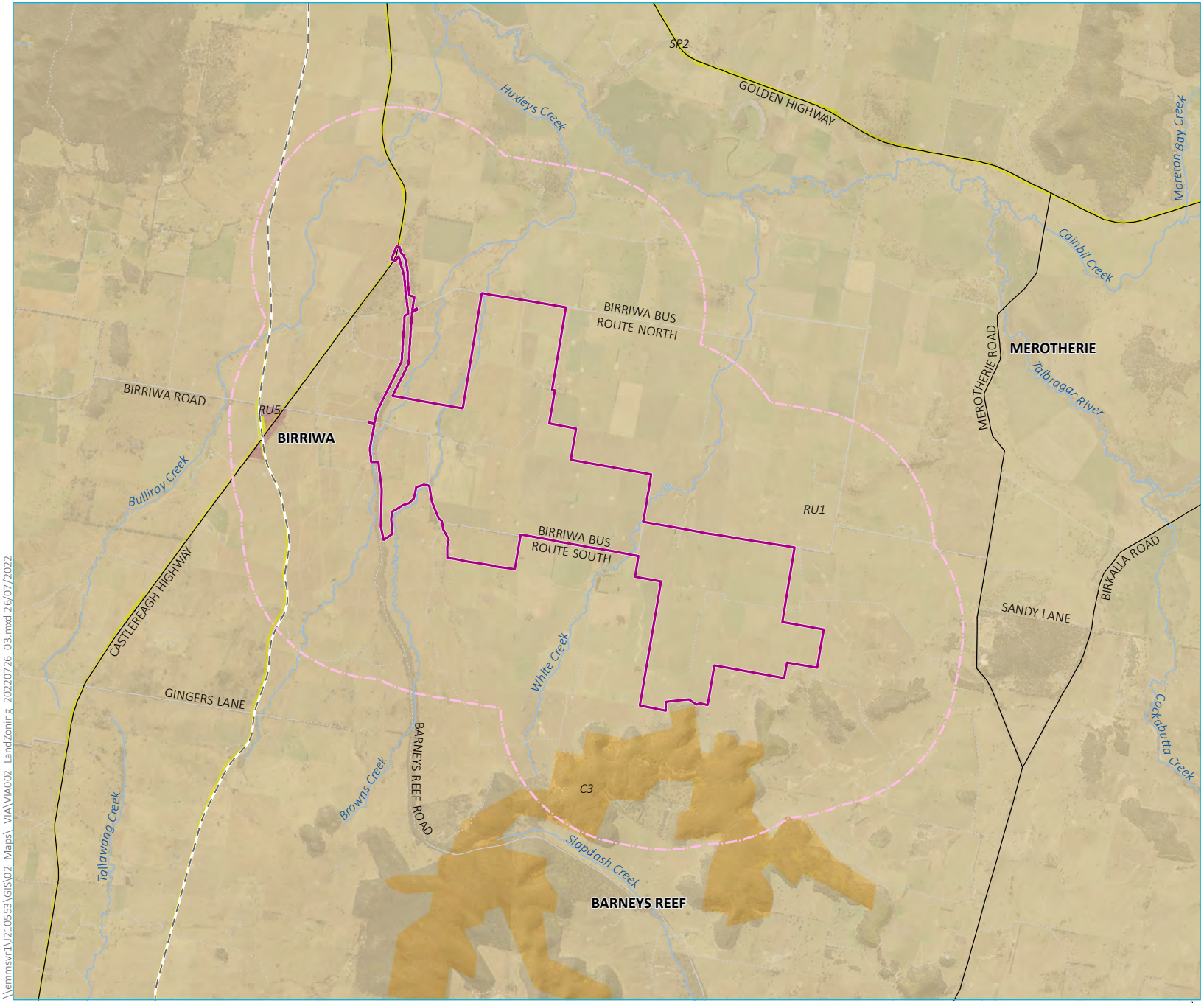
Project overview

Birriwa Solar and BESS Project
Visual impact assessment
Figure 2.1

EMM
creating opportunities



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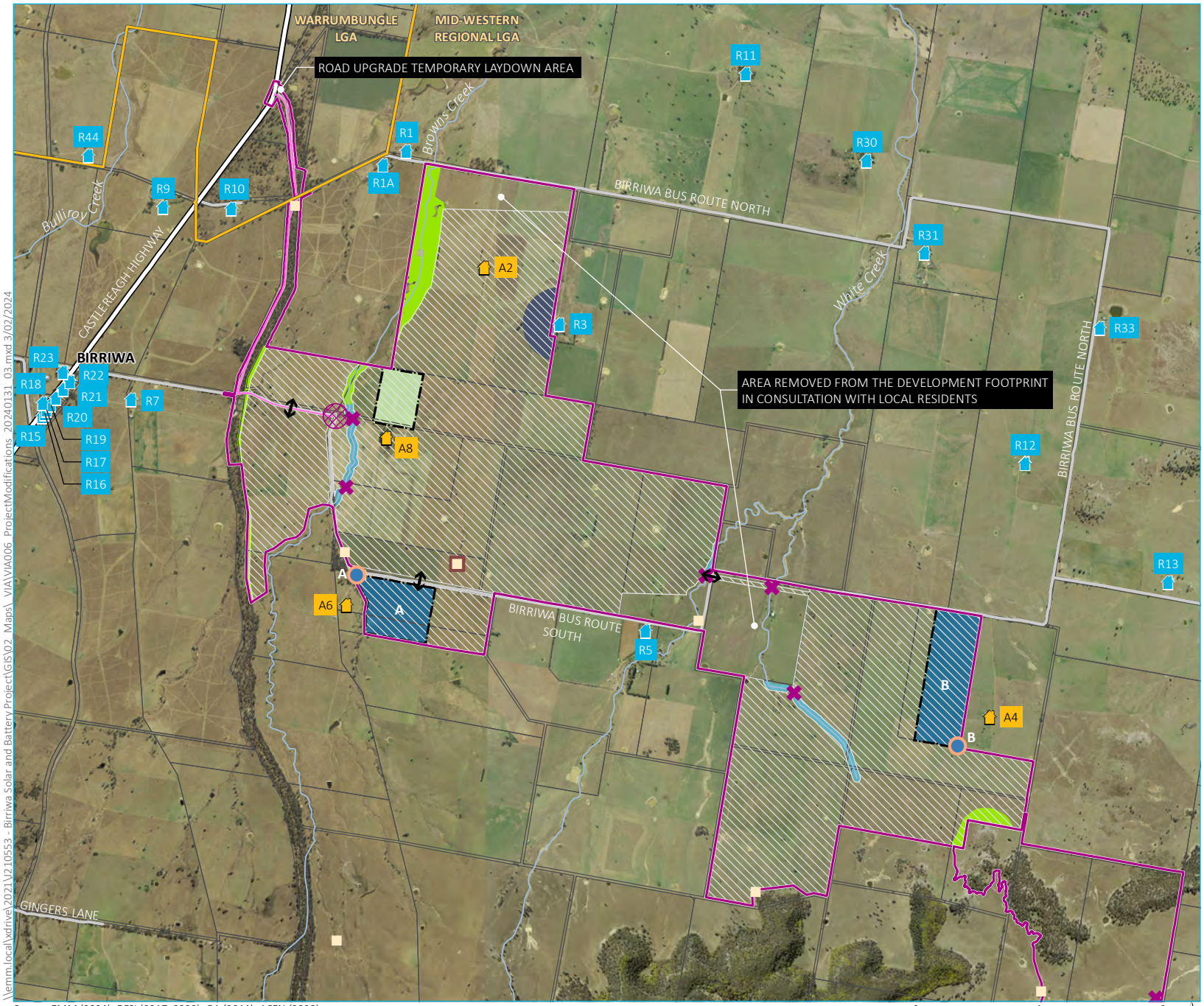
Source: EMM (2022); DPIE (2022); DFSI (2017); GA (2011); ACEN (2022)

Land use zoning

Birriwa Solar and Battery Project
Visual impact assessment
Figure 2.2

EMM
creating opportunities



KEY

- Study area

Impact footprint

- Development footprint
- Road upgrade corridor
- Restricted development area
- Solar panel setback
- Potential public road crossing location

Project layout

- Potential crossing point
- Proposed access point to the project
- Connection point (option A or B)
- Proposed operational infrastructure area including substation, operational facility and BESS (option A or B)
- Temporary construction compound

Existing environment

- Dwelling not associated with the project
- Dwelling associated with the project
- Aboriginal heritage site (to be salvaged)
- Aboriginal heritage site (to be avoided)
- Vegetation to be retained
- Major road
- Minor road
- Watercourse
- Cadastral boundary
- Local government area boundary

Source: EMM (2024); DFSI (2017, 2022); GA (2011); ACEN (2022)

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Project modifications to reduce impacts

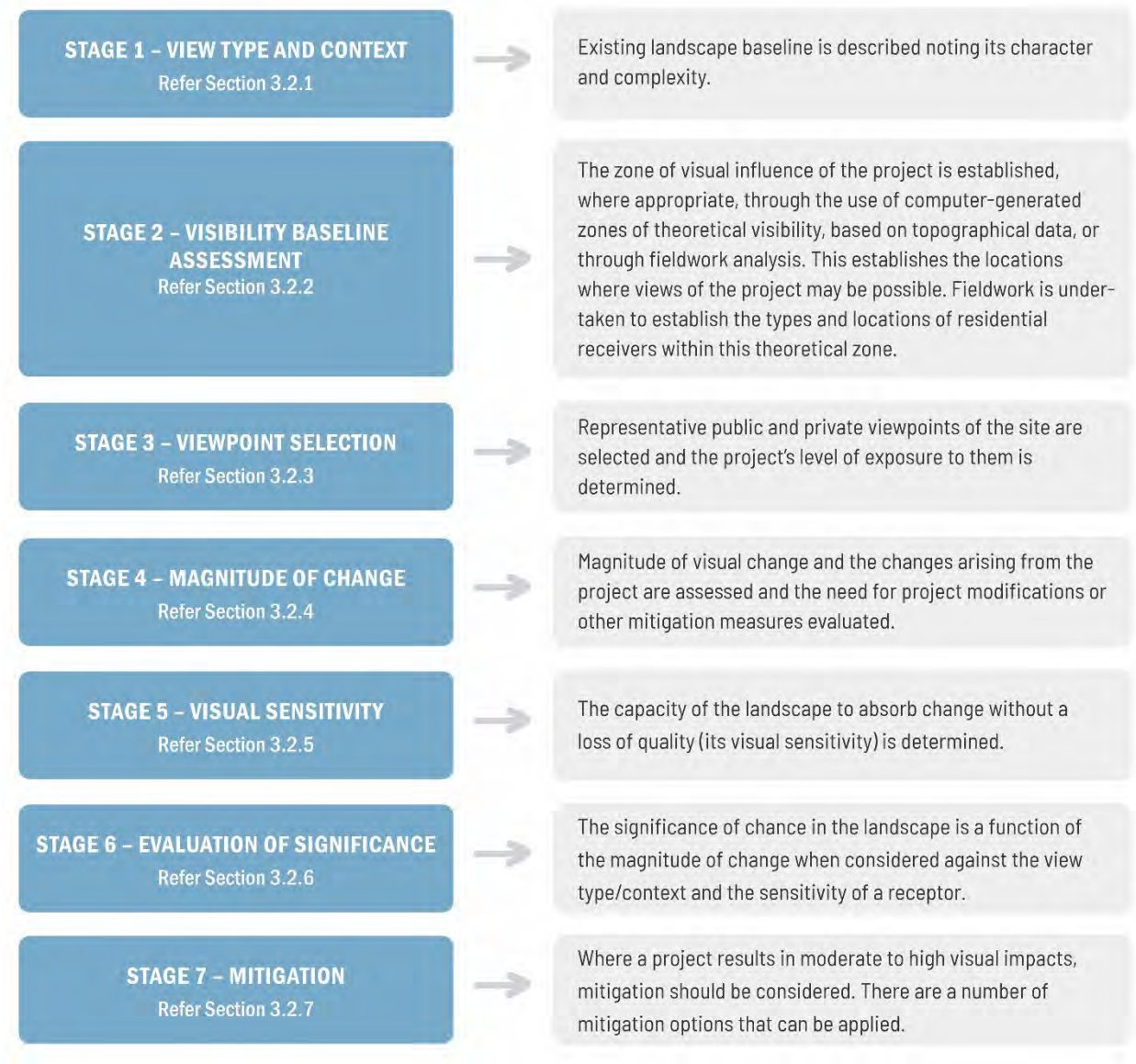
Birriwa Solar and Battery Project
Visual impact assessment
Figure 2.3

EMM creating opportunities

3 Assessment methodology

3.1 Overview

The assessment method used in this report is that outlined in the GLVIA and VA Bulletin, which involves information review, consultation, field observations and photography, computer-based data processing and analysis, and application of subjective professional judgement. The assessment involves seven key stages:



Details of each of the stages are provided below.

In addition to each of the stages described above, the project refinement process has also responded to identified potential visual impacts from the project. Subsequently, consideration of the effect of project refinement on potential for visual impacts to be experienced at each of the selected viewpoints has been provided in Section 5.3 of this report.

3.2 Stages in the assessment methodology

3.2.1 Stage 1 – view type and context

This stage involves recording and analysing the existing landscape features, characteristics, the way in which the landscape is experienced, and the value or importance placed on the landscape and visual resource of the site.

The landscape character is determined by the number, size, type and contrast of elements present. Typically, the key elements are topography, vegetation, water features and built elements. Other factors that are important are the consistency of these elements and whether they have developed progressively over time and become well integrated into a harmonious landscape. In addition, consideration must be given to the prevalence of change, including whether the landscape is experiencing large-scale development (such as residential growth on the urban fringe).

The context is a primary factor in the visual sensitivity of the view. Generally, sites within higher contrasting landscapes have greater ability to absorb change, whereas sites within a uniform or highly ordered landscape have higher sensitivity and less potential for absorption.

Reference has been made to the landscape characters defined in the VA Bulletin and descriptions provided in the Interim Biogeographic Regionalisation for Australia (IBRA) (Thackway and Cresswell 1995). The GLVIA also sets out guidance in relation to landscape baseline at paragraph 5.3:

> Baseline studies for assessing landscape effects require a mix of desk study and fieldwork to identify and record the character of the landscape and the elements, features and aesthetic and perceptual factors which contribute to it. They should also deal with the value attached to the landscape.... The methods used should be appropriate to the context into which the development proposal will be introduced and in line with current guidance and terminology.

3.2.2 Stage 2 – visibility baseline assessment

Baseline studies for visual effects establish the area in which the project may be visible, who will see the project infrastructure, the viewpoints that will be affected and the nature of the views at those points. Viewshed analysis using geographic information system (GIS) has been used to simulate visibility from viewpoints and the surrounding landscape.

3.2.3 Stage 3 – viewpoint selection

Viewpoints are selected to provide a representative sample of the likely visual landscape changes on the different users of the areas surrounding the project and their visual exposure to various project elements. Viewpoints that are considered to have potential exposure to various project elements or areas available to public access, such as roads, and private viewpoints from residential properties surrounding the project, have been identified through GIS mapping, fieldwork, stakeholder engagement and desktop analysis.

As well as informing the project refinement process, feedback received from residents and the local community as part of stakeholder engagement activities has also informed the selection of the eight viewpoints described in Section 5.1. The viewpoints presented as part of this report are considered representative of potential visual impacts from a number of the locations identified as areas of concern by the local community, including local roads and private viewpoints from residential properties.

3.2.4 Stage 4 – visual magnitude

The magnitude of change on the visual landscape is one factor in determining the significance of visual impacts of the project. In accordance with the GLVIA, this visual assessment considered the following criteria in determining the magnitude of change on a receptor:

- Whether the impact is temporary or permanent – impacts that are for a limited duration are considered less significant than those that occur for an extended period or are permanent.
- Distance of the viewer from the altered elements in the landscape – close proximity to an altered landscape will increase the significance for private residences. In the case of motorists, mid ground changes can be greater than foreground elements as they can result in longer viewing times. Glare and reflection has also been considered in regard to motorists.
- Length of viewing time – views from a residence are constant, whereas some views from roadways as experienced by motorists may be brief dependent upon speed and viewing direction.
- Extent of view affected – impacts that are visible over a greater portion of a view are more significant than those where only a part of the view is impacted. Intervening topography and vegetation will also affect the magnitude of change.
- Scale of change – the loss or addition of features in the view and changes in the proportion of the view affected by the project.

Table 3.1 Magnitude of change - viewing experience

	Distance from site (km)				
Duration of view	**0–0.5**	**0.5–1.0**	**1.0–2.5**	**2.5–4.0**	**>4.0**
Long (>10 minutes)	High	High	Moderate	Moderate	Low
Moderate (1–10 minutes)	High	Moderate	Moderate	Low	Low
Short (<1 minute)	Moderate	Low	Low	Low	Low

Table 3.2 Magnitude of change – scale

	Extent of view affected		
Scale of change	**High**	**Moderate**	**Low**
High	High	High	Moderate
Moderate	High	Moderate	Low
Low	Moderate	Low	Low

The two sensitivity ratings above are then combined to form the visual sensitivity rating as indicated in Table 3.3. This combined rating is applied to the visual impact rating shown in Table 3.7.

Table 3.3 Magnitude of change

	Viewing experience		
Scale of change	**High**	**Moderate**	**Low**
High	High	High	Moderate
Moderate	High	Moderate	Low
Low	Moderate	Low	Low

3.2.5 Stage 5 – visual sensitivity

Visual sensitivity is a measure of the landscape's ability to visually absorb development without a significant change in the character. It is a function of the view type and context. In this assessment, the major factor influencing visual sensitivity is the level of contrast between the project-related infrastructure and the rural landscape setting in which it will be set.

The physical characteristics of the landscape, including existing development features, are integral components in determining the visual sensitivity. For example, a low visual sensitivity would enable a modification or addition to be made to the landscape which would only cause minimal contrast and result in a high level of integration with the surrounding landscape. Similarly, a high visual sensitivity would mean the same modification or addition to the surrounding landscape would cause high contrast to the surrounding landscape.

The Draft Guidelines identify the view type as *viewer sensitivity* and the view context as *scenic quality*. Viewer sensitivity relates to the location of the viewer and the relative importance placed on the landscape viewed from that viewpoint by the community or visitors. These viewpoints include public use areas, public travel ways, and private homes.

Visual sensitivity has been assessed based on the viewer sensitivity level classification given in the VA Bulletin and The Draft Guidelines, presented in Table 3.4.

Table 3.4 Viewer sensitivity level classification

Viewer sensitivity	Description
High	Residential areas and rural villages (defined as land zoned R1, R2, R3, R4, R5 and RU5 in the *Standard Instrument Local Environmental Plan* [LEP]). Recreation, cultural or scenic sites and viewpoints of National or State significance such as National Parks, National reserves, and World Heritage areas. Any buildings, historic rural homesteads/residences on the State or local Government Heritage List.
Moderate	Rural dwelling(s). Tourist and visitor accommodation (definition in Standard Instrument LEP). Recreation, cultural or scenic sites and viewpoints of regional significance.
Low	Interstate and state passenger rail lines with daily daylight services. State highways, freeways and classified main roads, classified tourist roads. Land management roads with occasional recreation traffic. Walking tracks of moderate local significance or infrequent recreation usage. Other low use and low concern viewpoints and travel routes. Navigable waterways. Other low use and low concern viewpoints and travel routes.

Scenic quality refers to the relative scenic or aesthetic value placed on the landscape by the community. This is based on the presence of key landscape features known to be associated with community perceptions of high, moderate or low scenic quality. The scenic quality classifications used in this assessment are identified in Table 3.5.

Table 3.5 Scenic quality classification

Scenic quality	Landforms	Vegetation	Waterbodies
High	Isolated peaks, steep rocky ridges, cones or escarpments with distinctive form and/or colour contrast that become focal points. Larger areas of distinctive rock outcrops or boulders. Well defined, steep sided valley gorges.	Strongly defined patterns with combinations of eucalypt forest, naturally appearing openings, streamside vegetation and/or scattered exotics. Distinctive stands of vegetation that may create unusual forms, colours or textures in comparison to surrounding vegetation.	Visually prominent lakes, reservoirs, rivers, streams and swamps.
Moderate	Steep, hilly and undulating ranges that are not visually dominant. Broad shallow valleys. Moderately deep gorges or moderately steep valley walls. Minor rock outcrops.	Predominantly open forest or woodland combined with some natural openings in patterns that offer some visual relief. Vegetative stands that exhibit a range of size, form, colour, texture and spacing.	Intermittent streams, lakes, rivers, swamps and reservoirs.
Low	Large expanses of flat or gently undulating terrain. Indistinct, dissected or unbroken landforms that provide little illusion of spatial definition or landmarks with which to orient.	Extensively cleared and cropped areas with very limited variation in colour and texture.	Natural waterbody absent.

Source: Table 3 from VA Bulletin (DPE 2016).

The two visual sensitivity ratings above are combined to form the visual sensitivity rating as indicated in Table 3.6. This combined rating is applied to the visual impact rating shown in Table 3.7.

Table 3.6 Visual sensitivity rating

	Scenic quality		
Viewer sensitivity	High	Moderate	Low
High	High	High	Moderate
Moderate	High	Moderate	Low
Low	Moderate	Low	Low

3.2.6 Stage 6 – evaluation of significance

The significance of a change in the landscape is a function of the magnitude of that change when considered against the view type/context and the sensitivity of a receptor. Typically, a noticeable change in the landscape in a rural or natural landscape, combined with a high visual sensitivity, would be considered to be significant, whereas a change in an already heavily modified landscape would be considered slight or moderate.

Visual impact refers to the change in the appearance of the landscape because of development. This report addresses a number of factors that contribute to the visual impacts and has presented them in a measurable way.

Table 3.7 provides a matrix that combines the visual sensitivity rating with the magnitude of change rating to determine the visual impact rating. This rating is applied to each viewpoint as a way to measure the impacts of a development from particular locations.

Table 3.7 Evaluation of significance – visual impact rating

	Magnitude of change		
Visual sensitivity	**High**	**Moderate**	**Low**
High	High	High	Moderate
Moderate	High	Moderate	Low
Low	Moderate	Low	Low

The primary assessment tools for determining the significance of impact of the project are the site inspections and photographs of the views from the selected viewpoints. This enables an assessment of potential visual impact, taking into consideration the nature of the landscape, topography, the distance between the viewpoint and the proposed infrastructure, as well as the type of view experienced.

3.2.7 Stage 7 – mitigation

The final step in the assessment process is to determine additional measures that could be incorporated into the design of the project to ameliorate, or, where possible, eliminate the visual impact of the project.

Mitigation measures can be in several forms including:

- design of project infrastructure to reduce the contrast with the surrounding environment by:
  - moving arrays to less visible locations;
  - removing some project elements; and
  - re-sizing the project elements;
- use of visual buffers and screening by planting vegetation; and
- designing infrastructure to screen operations and lighting.

Mitigation measures that have been incorporated into the design of the project are discussed in Chapter 6 of this report.

4 Existing landscape character

4.1 Land use

The project is located in a semi-rural setting with the wider region characterised by grazing and cropping with scattered rural dwellings and villages (Birriwa).

The majority of the land surrounding the project is zoned RU1 primary production under the *Mid-Western Regional LEP 2012* (Figure 2.2). Land uses are predominantly agricultural, used primarily for sheep and cattle grazing or dry land cropping.

4.1.1 Historic heritage

There are no listed or known historic heritage items within the study area or immediate surrounds.

4.1.2 Aboriginal heritage

A search of the Aboriginal Heritage Information Management System (AHIMS) register identified no previously recorded sites within the study area. There are no sites in the study area currently or previously listed on the Commonwealth Heritage List or the National Heritage List. One Native Title Claim covers the study area, Warrabinga-Wiradjuri #7 (NC2018/002, NSD857/2017), which covers an area from Dunedoo to Lithgow.

A field survey of the study area was undertaken by OzArk with the assistance of registered Aboriginal parties (RAP) site officers and was completed over eight days. To offset the lack of visibility during field surveys (due to dense ground cover), the assessment also relied on an examination of the archaeological potential of the landforms present, which were broken into three survey units (drainages, flats and gentle slopes). The low survey efficacy on the flats and gentle slopes did not prevent the archaeological potential of these landforms being understood.

Eight Aboriginal sites were identified during the field survey (shown on Figure 4.1):

- White Creek OS-1 (artefact scatter with potential archaeological deposit (PAD)) – within the study area;
- Mangarlowe OS-1 (artefact scatter) – within the study area;
- Mangarlowe OS-2 (artefact scatter) – outside of the study area;
- Roxanna OS-1 (artefact scatter) – outside of the study area;
- Winora OS-1 (artefact scatter) – outside of the study area;
- Mangarlowe IF-1 (isolated find) – within the study area;
- Mangarlowe IF-2 (isolated find) – within the study area; and
- Barneys Reef Road ST-1 (scarred tree) – outside of the study area.

The dominant site type recorded was low-density stone artefact sites (predominantly consisting of unmodified flakes) and the dominant raw material was quartz with small quantities of basalt, quartzite, silcrete, mudstone and volcanic materials also identified. Six of the recorded sites were within 200 m of ephemeral drainage line.

Avoidance of Aboriginal cultural heritage values has been a key aspect of the project refinement process. Subsequently, only one Aboriginal site will be directly impacted by the project.

KEY

- Study area
- Study area buffer (2 km)
- Electricity transmission line (33 kV)
- Rail line
- Major road
- Minor road
- Vehicular track
- Named watercourse
- Cadastral boundary
- Waterbody
- Local government area

Recorded Aboriginal heritage site

- Aboriginal heritage site (to be salvaged)
- Aboriginal heritage site (to be avoided)

LEP-listed heritage item

- Item - General

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Source: EMM (2022); DFSI (2017); DPIE (2022); GA (2011); ACEN (2022)

0 1 2 km

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Heritage sites

Birriwa Solar and Battery Project
Visual impact assessment
Figure 4.1

EMM creating opportunities

4.2 Residences

A number of non-associated and associated residences have been identified within and surrounding the study area. Associated residences whose owners have a landholder agreement with ACEN for the project are identified with an 'A'. Non-associated residences that are not associated with the project and do not hold landholder agreements with ACEN and are identified with a 'R'.

There are four associated residences within or in close proximity to the study area (A2, A4, A6 and A8). There are 21 non-associated residences within 2 km of the study area, many of them in the township of Birriwa, and another 22 between 2 km and 5 km away. Some non-associated residences appear to be derelict or not in use at the time of lodgement of the EIS.

The locations of the receptors and representative viewpoints considered as part of this assessment are shown on Figure 5.2.

4.3 Roads

The main transport infrastructure is made up of the Castlereagh Highway (B55) and the Golden Highway (B84). Castlereagh Highway runs north-south approximately 1.4 km west of the project at the closest point. The Golden Highway runs east-west approximately 4 km north of the project.

There is a rail line connecting Birriwa to Dunedoo to the north and Gulgong to the south. The closest point the rail is to the project is approximately 1.5 km west.

Access to the project is off Castlereagh Highway via Birriwa Bus Route South or Barneys Reef Road. Both of these connect to Castlereagh Highway just north of Birriwa village.

Photograph 4.1 Birriwa Bus Route North

4.4 Towns

Birriwa is the rural centre for this northern area of the LGA. Census data (2016) indicates there are 49 people living in Birriwa – this includes residents in the surrounding area (including the study area). The closest project boundary is located approximately 1.5 km from Birriwa village.

Dunedoo is the closest town centre and is located 18 km north of Birriwa, by road. The closest town centre within the Mid-Western LGA is Gulgong, some 30 km south of Birriwa.

4.5 Vegetation

Much of the development footprint has been extensively cleared of trees and has been highly modified by historic farming practices.

The landscape typical of the region is predominantly cleared, open grazing land with scattered groupings of remnant native trees. Existing vegetation is generally found along drainage lines, roadsides and along the perimeter of paddocks and property boundaries.

The remnant vegetation throughout the area is derived from the following vegetation communities:

- Western Grey Box – Cypress Pine shrub grass shrub tall woodland along Barneys Reef Road (west of site);
- Yellow Box grassy woodland on lower slopes and valley flats within/around the study area;
- Rough-Barked Apple – Red Gum – Yellow Box woodland near the southern boundaries of the study area; and
- Queensland Bluegrass – Redleg Grass – Rats Tail Grass – Spear Grass – Panic Grass derived grassland along the lower slopes of Barneys Reef (south of site).

4.6 Topography

Most of the project falls from the lower slopes of Barneys Reef, which runs east to west along the southern boundary of the project. The elevation falls from 500 m AMSL to approximately 420 m at the north-western corner of the project. There are waterways running through the site from south to north toward the Talbragar River. These waterways have shaped the landscape creating low undulating hills and valleys across the landscape.

Photograph 4.2 Typical landscape character

4.7 Landscape values

Mid-Western Regional Council has identified enhancing and protecting the region's biodiversity and natural heritage as a key planning priority in their *Strategic Planning Statement* (2020). This would indicate there is a high value placed on the natural landscape. Elements like waterways that support vegetation and wildlife would have a high community value. This would be true of wooded areas like Barneys Reef as well. No significant scenic vistas have been identified as having potential to be impacted by the project.

4.8 Night lighting

The main sources of night-time lighting are residential dwellings, especially those clustered in the village of Birriwa. Other farmhouse dwellings are located sporadically across the landscape and tend to be located individually, minimising the amount of light spilling into the sky.

Other sources include headlights from vehicles along the Castlereagh Highway and the Golden Highway and trains along the railway. The headlights tend to be focused light, illuminating the area in front of the vehicles.

The project sits within the Dark Sky Region surrounding the Siding Spring Observatory. Developments within this area are required to apply good lighting design principles that eliminate light spill. These principles are illustrated in the *Dark Sky Planning Guideline* (2016), and include:

- eliminating upward spill light;
- directing light downwards, not upwards;
- use of shielded fittings;

- avoiding ‘over’ lighting;
- switching lights off when not required;
- use of energy efficient bulbs;
- use of asymmetric beams, where floodlights are used;
- ensuring lights are not directed towards reflective surfaces; and
- use of warm white colours.

4.9 Airfields

There are two airfields that may be affected by the Birriwa Solar and Battery Project. These are the Dunedoo airfield and the Dunedoo hospital helipad.

- The Dunedoo airfield (YDNO) is located 9.3 km northwest of The Project site. The flight path for the airstrip appears to be southwest to northeast. Therefore, aircraft are not flying over the solar arrays nor are they forced to fly within close proximity to The Project as they approach for landing. There is little potential for impacts on aircraft from reflection or glare from the solar arrays.
- The Dunedoo hospital helipad (YXDN) is located 14.2 km northwest of The Project site. Helicopters approaching and leaving the helipad are not forced to fly above or near the solar arrays, and therefore should not be affected by reflection or glare from the solar arrays.

4.10 Other development

RES is seeking approval to develop the Barneys Reef Wind Farm along the southern slopes of Barneys Reef. The project includes 63 wind turbines with supporting BESS and electrical infrastructure. The turbine locations begin along the Castlereagh Highway at Gingers Lane and stretch to Merotherie and Bungaba in the east. The closest proposed turbine location is 3 km south west of the study area on the western side of Barneys Reef. On the eastern side of Barneys Reef (Merotherie) the closest proposed wind turbine location is 2.4 km from the study area.

ACEN is seeking approval to develop the Valley of the Winds wind farm, which is located north of the Golden Highway. The closest turbine is 9 km north of the study area, between Leadville and Uarbry. The wind farm stretches northward to Coolah.

Based on the visual impact assessments of these wind farms, both will be visible from the study area and its surrounds. The potential for cumulative impacts is addressed in Section ES.4 of this report.

5 Visual assessment

5.1 Assessed viewpoints

As part of the preparation of this VIA, a number of site inspections have taken place during late 2021 and early 2022. The purpose of these site inspections has been to ground-truth the representative viewpoints identified during the initial desktop analysis and discuss potential views of project infrastructure with residents. During these inspections, photographs from these representative viewpoints were captured and a selection of these photographs has been provided in the following sections as part of the viewpoint analysis.

A zone of visual influence analysis (ZVI) was conducted using GIS (refer to Figure 5.1). Based on a 'bare earth' digital model, the ZVI predicts where the project will be visible from. This is expressed in theoretical percentages and includes the associated and non-associated receivers. The ZVI was carried out to four km with a one km and a two km buffer zone indicated.

Figure 5.2 identifies the photograph locations and viewing directions and Table 5.1 provides the rationale for selecting each photograph location. The representative viewpoints were selected based on the following criteria:

- proximity to the PV arrays and other project infrastructure;
- the location of receptors (ie dwellings) and other local features (eg Birriwa village and the Central West Cycle Trail);
- the positioning of regional and local roads and potential impacts on passing motorists;
- local topography; and
- presence of remnant vegetation and wind breaks with potential to provide screening.

As outlined in Section 4.2, the locations of the residential receivers considered as part of this assessment are provided on Figure 5.2. As part of the preparation of this VIA, a total of 38 residences which were not associated with the project (non-associated residences) were identified within 4 km of the study area. There are a total of 21 non-associated residences within 2 km of the development footprint. Five dwellings are located within 1 km and 14 are located between 1 km and 2 km from the development footprint.

Eight representative viewpoints were selected from locations near residences and main roadways near the project. The locations of the eight viewpoints considered as part of this assessment are illustrated on Figure 5.2.

Visual assessments were also performed for the Central West Cycle Trail (CWCT), Birriwa village and selected residences that have potential for visual impacts.

Visual assessments were not conducted from the residences associated with the project. Landholder agreements include acceptance of visual impacts by virtue of being associated with the project.

Source: EMM (2024); DFSI (2017, 2022); GA (2011); ACEN (2022)

0 2.5 5 km

GDA 1994 MGA Zone 55

N

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KEY

- Study area
- Sensitive receptor
- Access road connection
- Major road
- Minor road
- Watercourse
- Topographic contour (25 m interval)
- Study area buffer

Viewshed assessment location

- Solar panel array
- BESS

Percent area visible to assessment locations

100%

>0%

Zone of visual influence

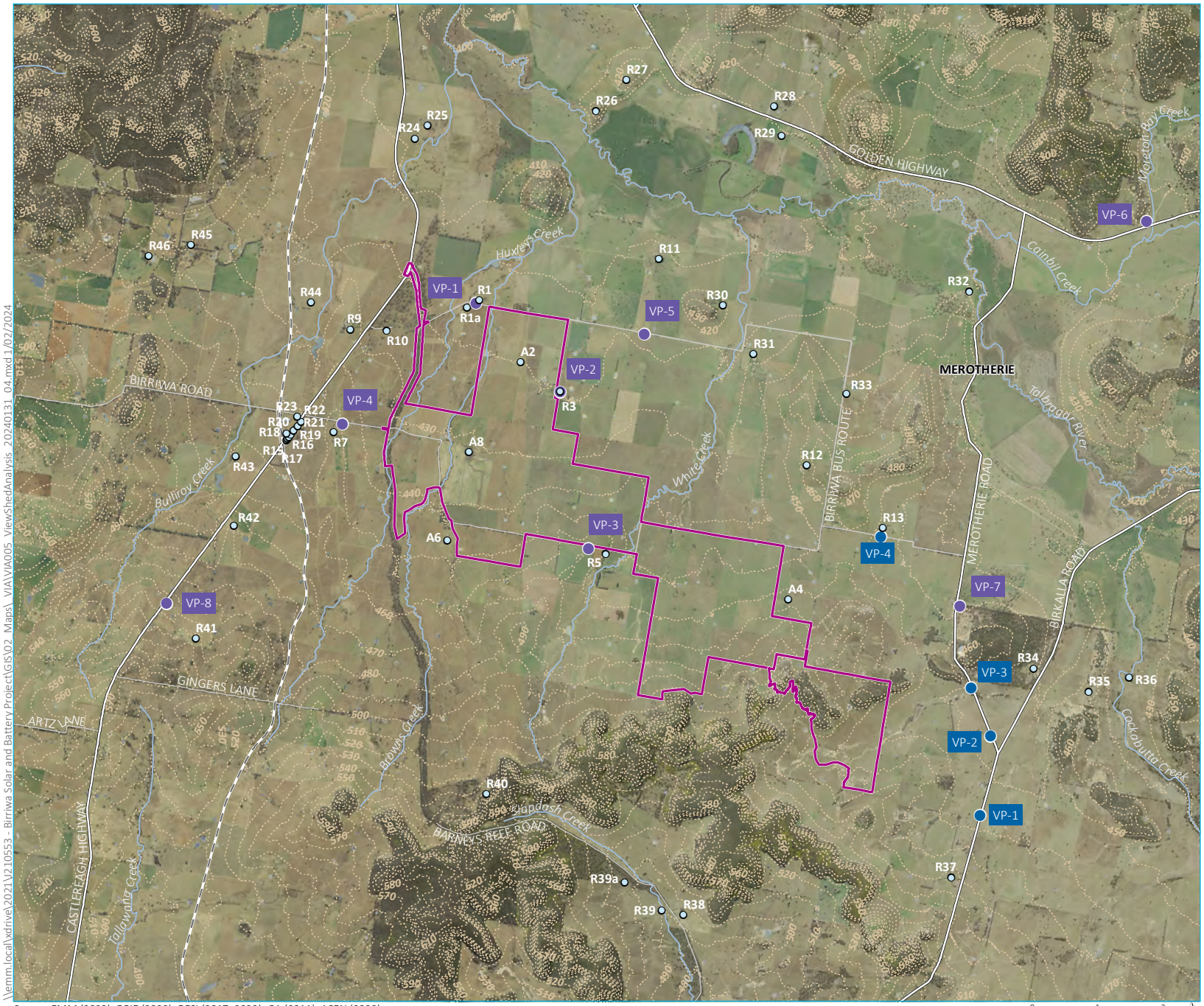
Birriwa Solar and Battery Project
Visual Impact Assessment
Figure 5.1

EMM creating opportunities

Table 5.1 Assessed viewpoints, receptors and rational for selection

Assessment location	Viewpoint type(s)	Representative receptors	Distance to development footprint*	Rationale for selection
Viewpoint 1	Dwellings and Motorists	R1, R1a, motorists along Birriwa Bus Route North	0.5 km	This view is from Birriwa Bus Route North, which travels along the north boundary of the study area. The view is also representative of views from residences north of the project.
Viewpoint 2	Dwelling	R3	0.05 km	This view is from a single residence along the eastern boundary of the development footprint. It is potentially one of the most impacted dwellings in relation to views of the project.
Viewpoint 3	Dwellings, cyclists and motorists	R5, motorists along Birriwa Bus Route South	0.1 km	This view is from the roadway adjacent to a single dwelling along the southern boundary of the development footprint. It is potentially one of the most impacted dwellings in relation to views of the project (noting a buffer has been included in the design). This viewpoint is also representative of views experienced by cyclists on the Central West Cycle Trail, which runs along Birriwa Bus Route South.
Viewpoint 4	Dwelling and cyclists	R7, Motorists along Birriwa Bus Route South	0.9 km	This is the view from a dwelling west of the study area. It is representative of potential views from the Birriwa village and dwellings along the Castlereagh Highway. This viewpoint is also representative of views experienced by cyclists on the Central West Cycle Trail, which runs along Birriwa Bus Route South.
Viewpoint 5	Dwellings and Motorists	R11, R30, R31	2.25 km	This is the view from a road north/north-east of the project. It is representative of views from dwellings and locations approximately 1 km from the development footprint.
Viewpoint 6	Motorists	Motorists along highway	7.0 km	This represents the typical view from the Golden Highway traveling west with distant views toward the project.
Viewpoint 7	Cyclists and motorists	R13, Motorists along Merotherie Rd	2.5 km	This represents the typical view from Merotherie Road, which runs approximately 2 km east of the project. This viewpoint is also representative of views experienced by cyclists on the Central West Cycle Trail, which runs along Birriwa Bus Route South.
Viewpoint 8	Motorists	R41, R42, Motorists along Castlereagh Highway	4.0 km	This represents the typical view from the Castlereagh Highway with distant views toward the project.
Central West Cycle Trail	Cyclists	Cyclists	0.02 km	This considers views for cyclists along the length of the CWCT that extends adjacent to the development footprint for 7.5 km.
Birriwa village	Dwellings	R14, R15, R16, R17, R18, R19, R20, R21, R22	1.4 km	This view is from the rural township consisting of residential buildings.

* The distances shown in the table are taken from the development footprint, not specific project elements.



Source: EMM (2022); DPIE (2022); DFSI (2017, 2022); GA (2011); ACEN (2022)

\\emm.local\xdrive\2021\210553 - Birriwa Solar and Battery Project\GIS\02 Maps\ VIA\VIA005 ViewShedAnalysis 20240131 04.mxd 1/02/2024

Location of residences and viewpoint locations

Birriwa Solar and Battery Project
Visual impact assessment
Figure 5.2

EMM creating opportunities

5.2 Construction impacts

A description of the site establishment and construction activities associated with the project is provided in Chapter These impacts are considered temporary with the construction period estimated to be approximately 28 months. The main temporary visual impacts are identified below.

- Traffic and vehicle movements:
  - Vehicle movements will be a daily occurrence during the construction stage of the project. Most traffic into the development footprint is expected to be from the north (Dunedoo and the Golden Highway and Castlereagh Highway). Access to the project will be via Barneys Reef Road, which leaves Castlereagh Highway some 2.7 km north of the Birriwa village. The residences most likely to be affected are the residences at R10, R1 and R7, due to their proximity to Barneys Reef Road and the entry to the development footprint. However, due to topography and vegetation, visual impacts from traffic are not expected at these locations.
  - As construction work proceeds, vehicles may be visible along internal access tracks.
- Temporary laydown area:
  - The laydown area for the project during construction has been identified and will be located east of the vegetated watercourse, as shown in Figure 2.1.
  - A second, smaller laydown area for road upgrades may be located near the intersection of the Castlereagh Highway and Barneys Reef Road. This may be visible from the highway, but it will be a short-term impact.
- Machinery installing solar panels:
  - As construction progresses, machinery movement will be visible in various locations across the development footprint. While the activity will be contained within the development footprint, movement of vehicles and any dust generated will attract the human eye and may seem more noticeable. This is due to the human eye and its response to movement.
- Construction of BESS enclosures and buildings:
  - The BESS will be made up of components including battery enclosure units, inverters, transformers, ventilation systems and fire protection systems. The BESS will be adjacent to the substation within one of two proposed operational infrastructure areas and will be housed within either outdoor standalone racks, shipping containers or dedicated use buildings. The specific design details for the BESS and their respective enclosure types have not been confirmed.

Motorists travelling along the local and regional road network may experience views of the development footprint during construction. It is assumed the focus of these motorists will be in line with their direction of travel along the road corridors, minimising their views into the development footprint.

Cyclists riding along the CWCT (which includes Birriwa Bus Route South) will also have views into the development footprint during construction. These views will occur over a longer period of time as cyclists make their way along the cycling trail. Additionally, the trail will be detoured around the construction works near Barneys Reef Road, which will be the entry to the development footprint for the construction traffic.

As the project site establishment works and construction activities are considered temporary, landscaping is not proposed to mitigate visual impacts during the construction stage of the project.

5.3 Operation impacts

An assessment of the selected viewpoints in accordance with the methodology outlined in Chapter 3 of this report is presented in the following sections.

To determine the potential visibility of project infrastructure, a viewpoint analysis study was performed. This uses GIS data to simulate the visibility of the project from a specific viewing location. The results of the viewpoint analysis are presented in Sections 5.3.1–5.3.12.

The viewpoint analysis was generated using a digital elevation model (DEM) and a digital surface model (DSM), both of which cover the development footprint, the eight selected viewpoints and their immediate surrounds. The DEM and DSM were built using publicly available ELVIS spatial data from the Foundation Spatial Data Framework.

The DEM is representative of the bare earth surface and only takes into account the topography of the landscape. The DSM is representative of the actual surface of the earth and considers a variety of different features in the landscape, including vegetation and built structures (eg rural dwellings, farm sheds and agricultural infrastructure).

A viewshed analysis based on the DSM alone cannot be used to identify the potential visual impacts of the project as it does not provide a true representation of the ability of certain features to shield views of project infrastructure from a given location. For example, in the case of vegetation, a viewshed analysis based only on the DSM may exaggerate the shielding potential of this feature. In reality, depending on the nature of the vegetation (eg canopy cover only), views of project infrastructure through vegetation may still be possible. Subsequently, the results of the viewshed analysis presented in this section have included results from both the DEM (layer titled, 'visible project infrastructure – bare earth surface') and the DSM (layer titled, 'visible project infrastructure – accounting for shielding features in the landscape').

To assist with the interpretation of the results presented in the figures below, the reader should consider the total area identified as 'visible project infrastructure – bare earth surface' as representative of the worst-case scenario for each viewpoint (ie the maximum visible extent of project infrastructure from the selected viewpoint). The total area identified as 'visible project infrastructure – accounting for shielding features in the landscape' should be considered representative of the best-case scenario for each viewpoint (ie the minimum visible extent of project infrastructure from the selected viewpoint).

The viewshed analysis presented in the figures in this section only considers the height of the dominant project infrastructure, ie the PV modules. As part of the viewshed analysis, the height of the PV modules was conservatively assumed to be 4.7 m.

Other project infrastructure including PCUs, substations, BESSs, O&M facilities and ETLs have not been considered as part of the viewshed analysis. The exact location of this infrastructure within the development footprint is not specified at this stage of the project's development and will be determined during the detailed design stage of the project. For example, the location of the PCUs will be dependent upon the type of inverter chosen. The proposed footprints for substation and BESSs have been positioned within the development footprint with a view to minimising or avoiding visual amenity impacts on nearby residences wherever possible.

One of the key criteria considered during the selection of the potential substation/BESS footprints identified on Figure 2.1 has been proximity to rural dwellings. Based on field investigations and a review of aerial imagery, it is anticipated that views of this infrastructure will be at least partially screened from all of the selected viewpoints. This is primarily due to undulation of the land and remnant vegetation in the landscape combined with the distance between the viewpoints and infrastructure. Further, as noted in Section 2.3, it is anticipated that the BESSs will be housed within either a number of small enclosures/cabinets or larger battery buildings. Regardless of the housing selected during the detailed design stage of the project, this infrastructure will be designed to integrate with existing elements in the landscape wherever possible, having regard to form, height and colour. Should they be required, the large building type of enclosures will be similar in appearance to the large agricultural sheds, which currently exist in the landscape within the three array areas and their surrounds.

The acoustic walls have also been assessed in conjunction with the BESS structures. The proposed walls are located in the same compound as the structures enclosing the BESS infrastructure. These walls may not be as tall as the BESS enclosures, and for the purposes of this assessment, the larger structure has been used for the visual impact assessments and the glint and glare assessment. The assumptions are hence considered conservative.

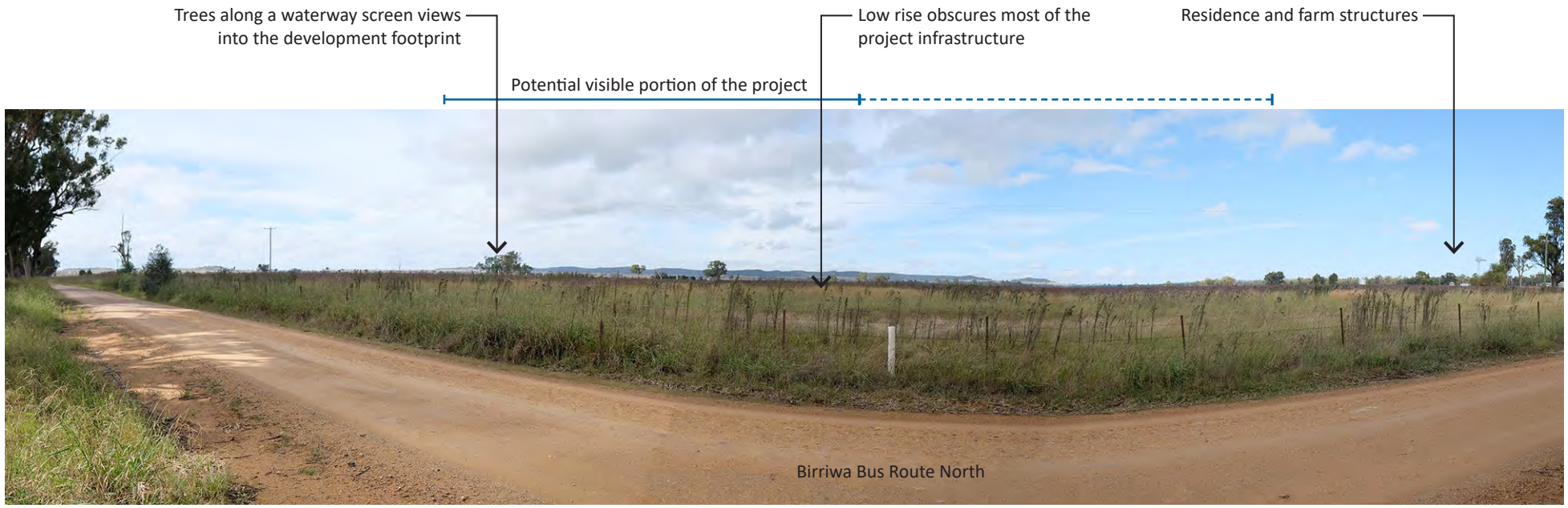
When considering the bare earth surface (ie topography) within the development footprint and surrounds, the results of the viewshed analysis indicate that project infrastructure will be visible to varying degrees from seven of the eight viewpoints assessed as part of this VIA.

By accounting for potential shielding features within the landscape (eg vegetation) both within the development footprint and surrounds, the number of viewpoints anticipated to experience views of project infrastructure reduces from seven to five viewpoints. However, as noted above, there are limitations to relying on the results of a viewshed analysis that includes consideration of a DSM. Nonetheless, the results presented in the following sections indicate the potential for shielding features in the landscape to reduce the visibility of project infrastructure from a number of the selected viewpoints. This is largely due to scattered remnant vegetation, planted wind breaks and extensive vegetation screens around the boundaries of rural residential dwelling.

The identification of visual impacts from the project did not rely solely on the viewshed analysis. Photographic evidence was used to examine the human experience of the visual changes proposed. Therefore, in determining the visual impact, the viewshed analyses should be considered in conjunction with the photographic representation for each viewpoint.

Table 6.2 in Section 6.5 provides a summary of the outcomes of the impact assessment, along with mitigation measures proposed.

5.3.1 Viewpoint 1 - Birriwa Bus Route North



Distance from development footprint	550 m
Duration of view	Long-Residence Short-Road
Viewing experience	High
Scale of change	High
Magnitude of change	**High**
Viewer sensitivity	Moderate
Scenic quality	Low
Visual sensitivity	**Low**
Visual impact rating	**Moderate**

View type and context:

This view is from a Birriwa Bus Route North, approaching the study area from the east. The land is generally flat, with agricultural land that is cleared. Stands of trees are located along the roadway and along waterways.

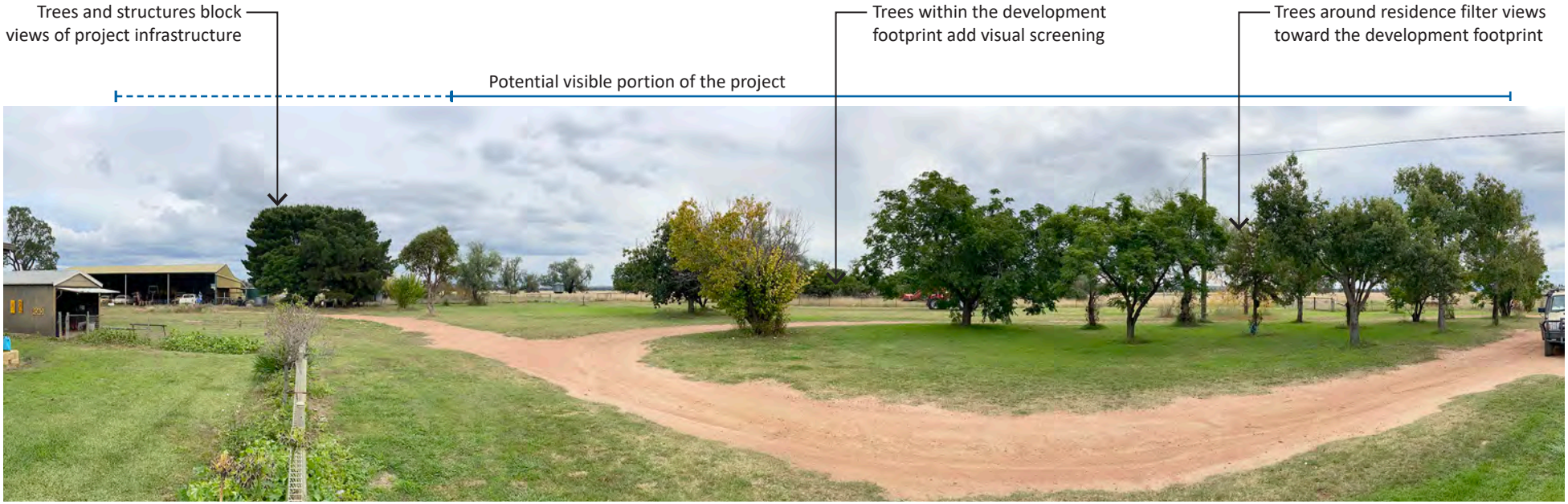
This viewpoint is located near the entry to two residences, and is also representative of a small number of residences located closer to Castlereagh Highway.

Potential visual impact:

From this location, the development footprint is located east and south. Views are screened by a low rise and the long grass in the foreground.

The development footprint sits on the hills beyond the visible tree line. Some distant views of the project components may be visible on the lower slopes of Barneys Reef.

5.3.2 Viewpoint 2 - Receptor R3



Indicative extent of development footprint likely to be visible

Indicative extent of development footprint likely to be screened

Distance from development footprint	50 m
Duration of view	Long
Viewing experience	High
Scale of change	High
Magnitude of change	**High**
Viewer sensitivity	Moderate
Scenic quality	Low
Visual sensitivity	**Low**
Visual impact rating	**Moderate**

View type and context:

This view is from a residential dwelling adjacent to the project boundary. The PV arrays will be located west and south of the dwelling.

The project infrastructure may be visible beyond the immediate trees that are located around the viewpoint, outside the development footprint.

Potential visual impact:

From this location, the project is located to the west of the viewer. It is unknown at the time of writing this report, whether the trees within the development footprint will remain to screen the PV arrays.

Views of the project components may be visible to the west and south of the dwelling, with potential distant views toward the south along Barneys Reef.

5.3.3 Viewpoint 3a - Birriwa Bus Route South

Indicative extent of development footprint likely to be visible

Indicative extent of development footprint likely to be screened

Distance from development footprint	65 m
Duration of view	Short - road
Viewing experience	Moderate
Scale of change	High
Magnitude of change	**High**
Viewer sensitivity	Moderate
Scenic quality	Low
Visual sensitivity	**Low**
Visual impact rating	**Moderate**

View type and context:

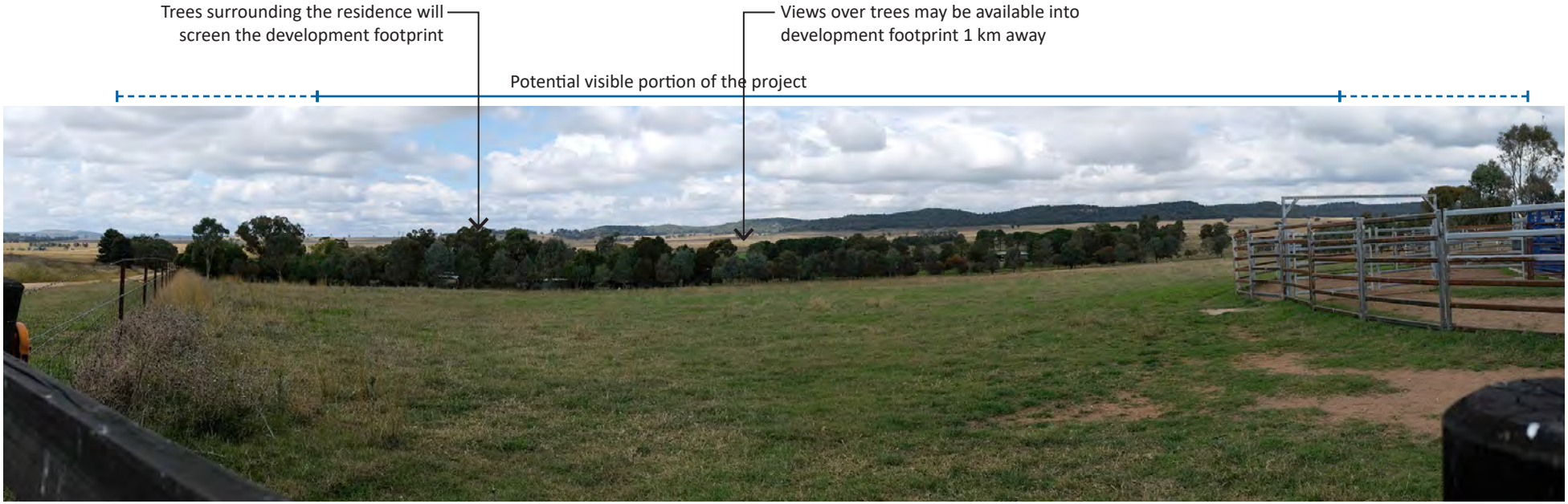
View from Birriwa Bus Route South facing north and west. The view is from a rise with views north into the development footprint.

This view is representative of views for motorists using the road and cyclists along the Central West Cycle Trail.

Potential visual impact:

The project infrastructure will be close to the road and therefore visible in the foreground with the land sloping down away from this viewpoint.

5.3.4 Viewpoint 3b - Birriwa Bus Route South



Indicative extent of development footprint likely to be visible

Indicative extent of development footprint likely to be screened

Distance from development footprint	65 m
Duration of view	Short - road
Viewing experience	Moderate
Scale of change	High
Magnitude of change	**High**
Viewer sensitivity	Moderate
Scenic quality	Low
Visual sensitivity	**Low**
Visual impact rating	**Moderate**

View type and context:

View from Birriwa Bus Route South facing east and southeast. The view is from a rise with views over a residence into the development footprint.

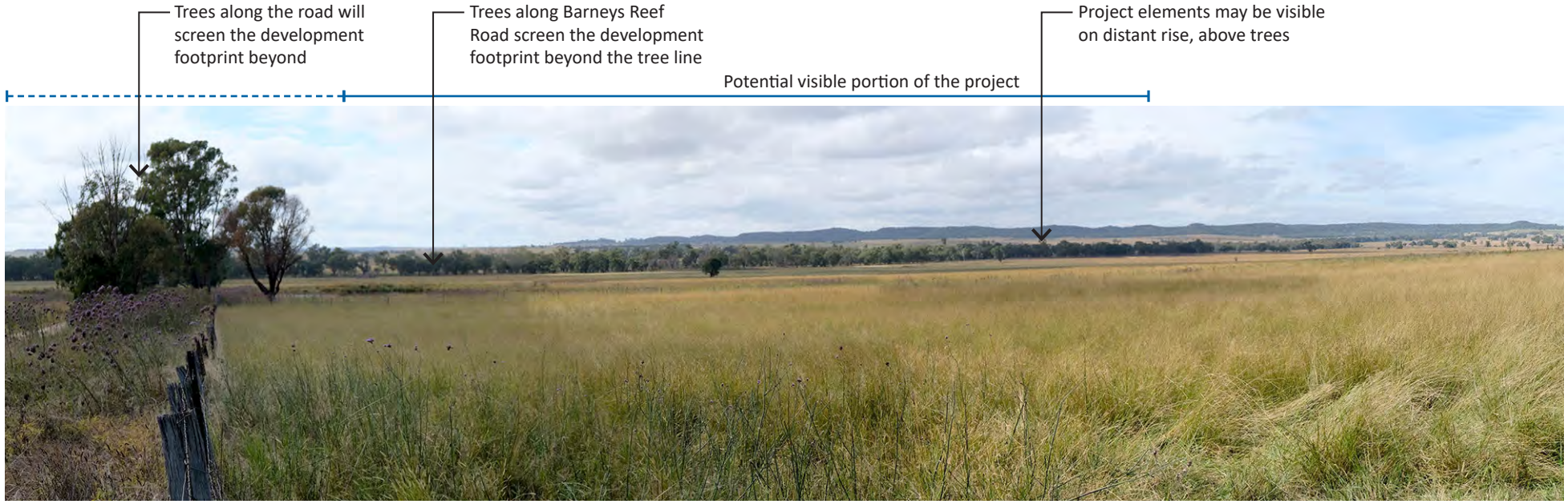
The eastern reaches of Barneys Reef are visible in the background.

This view is representative of views for motorists using the road and cyclists along the Central West Cycle Trail.

Potential visual impact:

Distant views may be available over the tree line to project infrastructure located 1 km away or more.

5.3.5 Viewpoint 4 - Birriwa Bus Route South



Indicative extent of development footprint likely to be visible

Indicative extent of development footprint likely to be screened

Distance from development footprint	900 m
Duration of view	Short - road Long - residence
Viewing experience	High
Scale of change	Low
Magnitude of change	**Moderate**
Viewer sensitivity	Moderate
Scenic quality	Low
Visual sensitivity	**Low**
Visual impact rating	**Low**

View type and context:

Immediate views from this location represent a typical rural setting with agricultural land. The prominent landscape element is the tree line along Barneys Reef Road with Barneys Reef in the distance, visible above the trees.

The view is facing southeast from a slight rise in the landscape with slopes down to the visible tree line.

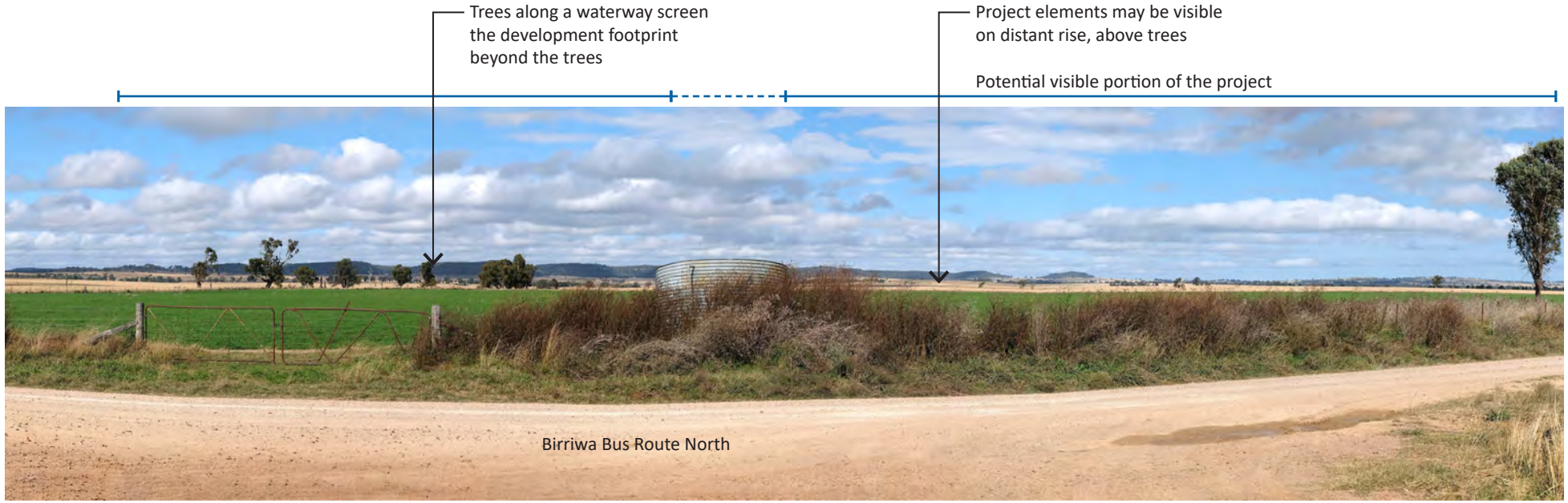
This view represents views from Birriwa Bus Route South, east of Castlereagh Highway, and the Central West Cycle Trail.

Potential visual impact:

Project infrastructure may be visible above the tree line located along Barneys Reef Road. PV arrays will stretch from Barneys Reef Road toward the south-east and along the base of Barneys Reef.

From this location, the existing trees screen views into the closest portions of the development footprint.

5.3.6 Viewpoint 5 - Birriwa Bus Route North



Distance from development footprint	2,250 m
Duration of view	Short - road Long - residence
Viewing experience	Moderate
Scale of change	Moderate
Magnitude of change	**Moderate**
Viewer sensitivity	Moderate
Scenic quality	Low
Visual sensitivity	**Low**
Visual impact rating	**Low**

View type and context:

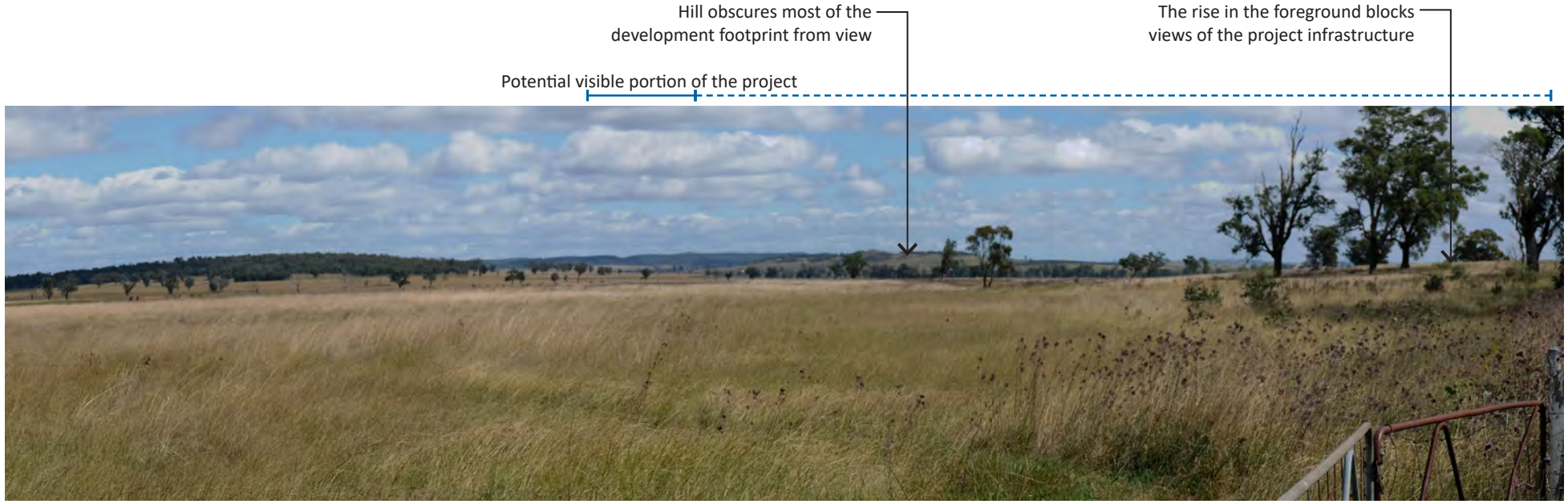
Immediate views from this location are dominated by agricultural land uses. This location is just over 2 km from the closest development footprint.

The view represents views from dwellings northeast of the study area and motorists along Birriwa Bus Route North.

Potential visual impact:

Views of the project infrastructure may be visible along distant slopes (2.25 km). PV arrays will stretch along the base of Barneys Reef and may be visible in the distance.

5.3.7 Viewpoint 6 - Golden Highway



Indicative extent of development footprint likely to be visible

Indicative extent of development footprint likely to be screened

Distance from development footprint	7,000 m
Duration of view	Short - road
Viewing experience	Low
Scale of change	Low
Magnitude of change	**Low**
Viewer sensitivity	Low
Scenic quality	Moderate
Visual sensitivity	**Low**
Visual impact rating	**Low**

View type and context:

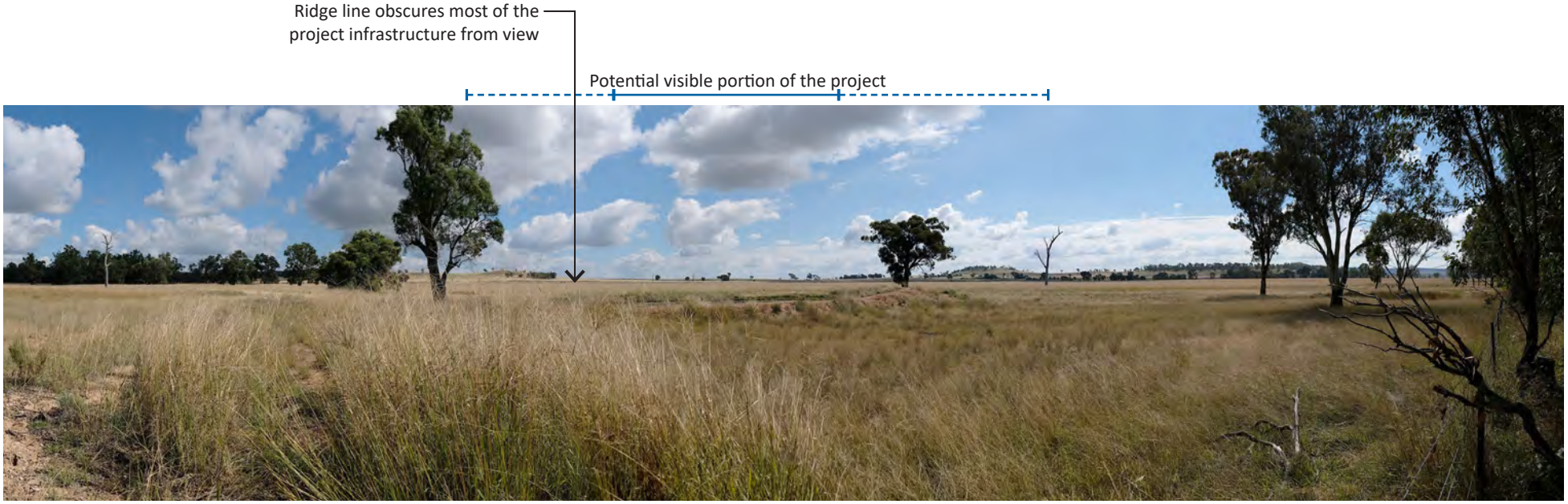
View from the Golden Highway approaching the Birriwa area from the east.

This location is 7 km from the closest portion of the development footprint.

Potential visual impact:

Views of the project infrastructure may be visible along distant slopes (8 km away). PV arrays located at the base of Barneys Reef may be visible in the distance.

5.3.8 Viewpoint 7 - Merotherie Road



Indicative extent of development footprint likely to be visible

Indicative extent of development footprint likely to be screened

Distance from development footprint	2,500 m
Duration of view	Short
Viewing experience	Low
Scale of change	Low
Magnitude of change	**Low**
Viewer sensitivity	Low
Scenic quality	Moderate
Visual sensitivity	**Low**
Visual impact rating	**Low**

View type and context:

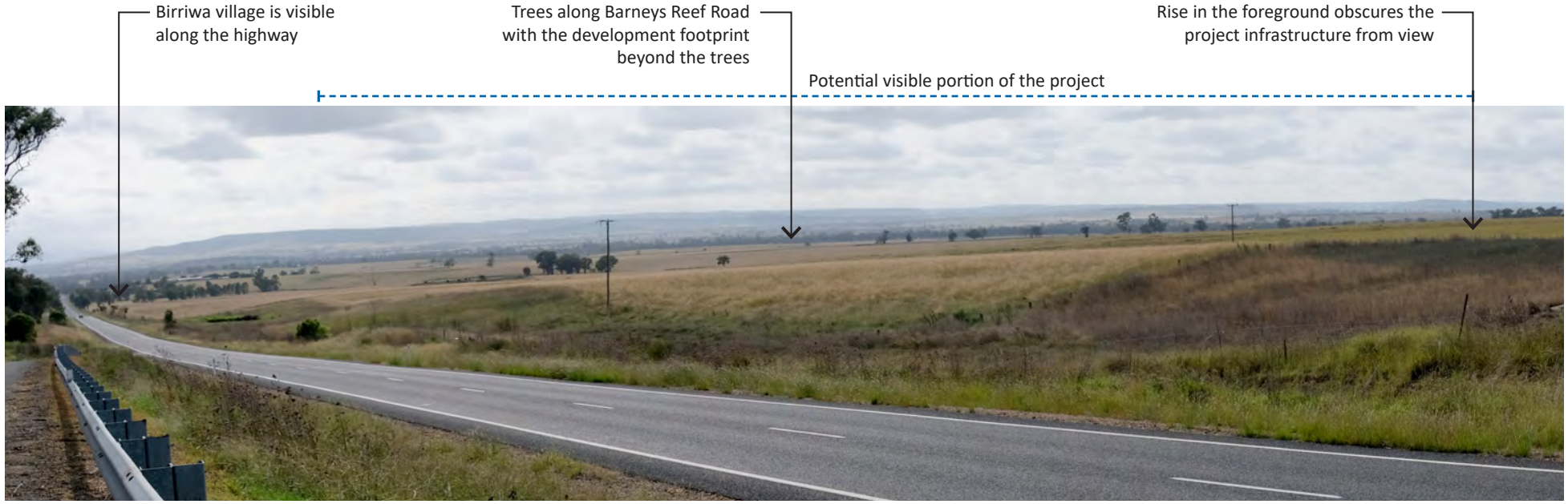
Views from this location represent a typical rural setting with large tracts of agricultural land.

Views are from Merotherie Road across grazing paddocks with a slight rise toward the development footprint.

Potential visual impact:

Views of the project components may be visible along the ridge line, with the development footprint beyond the hill and out of sight.

5.3.9 Viewpoint 8 - Castlereagh Highway



Indicative extent of development footprint likely to be visible

Indicative extent of development footprint likely to be screened

Distance from development footprint	3,800 m
Duration of view	Short
Viewing experience	Low
Scale of change	Moderate
Magnitude of change	**Low**
Viewer sensitivity	Low
Scenic quality	Low
Visual sensitivity	**Low**
Visual impact rating	**Low**

View type and context:

Large tracts of grazing land stretch across the landscape with trees marking waterways, roads and boundaries.

Views stretch across the valley with a dominant line of trees marking Barneys Reef Road, which forms the western boundary of the development footprint.

This location is 3.8 km from the closest part of the development footprint.

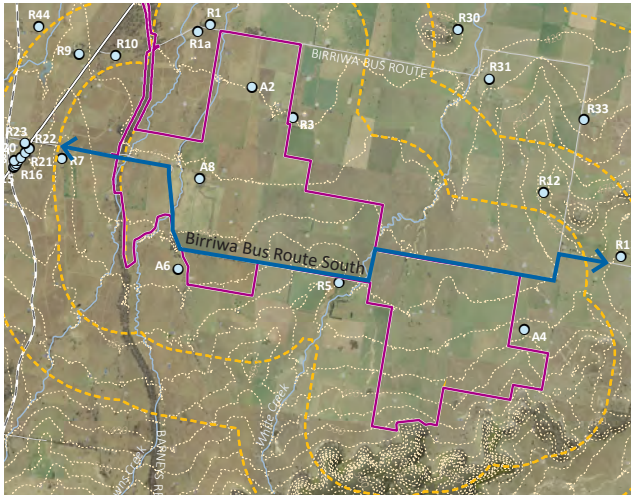
Potential visual impact:

Views of the project components may be visible in the distance. PV arrays will be located beyond the dominant tree line 3.8 km away.

This location also has the potential for cumulative impacts. The western-most wind turbines proposed for the Barneys Reef Wind Farm may be visible from this portion of the Castlereagh Highway.

5.3.10 Central West Cycle Trail

CWCT location in relation to the study area



Central West Cycle Trail route

Birriwa Solar and Battery project boundary

View from the CWCT - Birriwa Bus Route South travelling west

The roadway in the photograph above will have the project along the right side of the road.

View from the CWCT - Birriwa Bus Route South travelling east

The roadway in the photograph above will have the project along the left side of the road, with trees screening views.

Distance from development footprint	20 m
Duration of view	Moderate
Viewing experience	Moderate
Scale of change	High
Magnitude of change	**High**
Viewer sensitivity	Moderate
Scenic quality	Low
Visual sensitivity	**Low**
Visual impact rating	**Moderate**

View type and context:

The Central West Cycle Trail is located along Birriwa Bus Route South. It runs adjacent to the development footprint for 7.5 km. For most of that distance, the development footprint is on one side of the road. For 2.7 km of that distance, the development footprint is on both sides of the road.

Existing views from the CWCT is of agricultural land punctuated with trees along roadways, paddock boundaries and waterways.

Potential visual impact:

The project infrastructure will be close to the road and therefore visible in the foreground. However, there are roadside trees along most of Birriwa Bus Route South. Only 2.3 km of the distance is not screened by roadside trees.

This 7.5 km portion of the CWCT is part of a 58 km section of trail running between Gulgong and Dunedoo. The estimated time spent on this section of the CWCT is 20-30 minutes, whereas the time on the 58 km section is estimated at 3-3.5 hours. The relative time spent with views of the project is relatively short.

The CWCT also has potential for cumulative impacts since the Barneys Reef Wind Farm has proposed wind turbine locations southeast of the project. Travelling south, cyclists will leave the project and come into view of the wind farm.

5.3.11 Birriwa village

View from northern part of Birriwa across Castlereagh Highway facing east

The topography behind the residences screens views into the development footprint.

View from south part of Birriwa facing east

Trees and topography block views into the development footprint.

View from central part of Birriwa facing southeast

Trees and topography screen views toward the development footprint. Barneys Reef is visible in the background.

Distance from development footprint	1,400 m
Duration of view	Short - road Long - residence
Viewing experience	Moderate
Scale of change	Low
Magnitude of change	**Low**
Viewer sensitivity	High
Scenic quality	Low
Visual sensitivity	**Moderate**
Visual impact rating	**Low**

View type and context:

The main views are of a rural township consisting of a main road lined with residential buildings.

Views out of the village are of large tracts of grazing land trees marking waterways, roads and boundaries.

To the east of Birriwa village, a ridge line blocks views into the valley. The ridge is visible in the photographs above. It runs between the village and the project, effectively blocking views of the project.

Potential visual impact:

The project elements are not visible from locations in Birriwa Village.

5.3.12 Visual impacts on residences

The residences near the development footprint are likely to have varying degrees of visibility toward the project. Some of these will have fragmented views that are broken by existing vegetation, orientation of the dwelling or topography.

There are a total of 21 non-associated residences within 2 km of the development footprint (refer to Figure 5.1). Five dwellings are located within 1 km and 14 are located between 1 km and 2 km from the development footprint.

The majority of the residents located within 2 km from the development footprint, are located in Birriwa village. Ten of the residents form the village and are along Castlereagh Highway. Birriwa village is surrounded by agricultural land that is used for grazing or cropping. There are clusters of trees east of the village where the land rises slightly before dropping down to the waterway adjacent to Barneys Reef Road. The trees and the rise in topography screen most of the development footprint, however, it is likely that some views will be available from the vicinity of Birriwa village.

The highest visual impacts are likely to be experienced from dwellings within close proximity to the development footprint (closer than 1 km). This includes five residences that are located along Birriwa Bus Route North and Birriwa Bus Route South.

Table 5.2 Dwellings within 1 km of the development footprint

Dwelling	Location	Distance to development footprint	Visual assessment	Recommended mitigation measures
R1	261 Birriwa Bus Route North	550 m	The residence sits north of the road, which has trees planted along it. There are also trees along a water way between the residence and development footprint to screen views. Refer to Section 5.3.1 Viewshed Analysis figure, which illustrates the low potential for visual impacts. Based on the viewshed analysis: • magnitude of change is assessed as **Moderate**; • visual sensitivity is assessed as **Low**; and • visual impact rating assessed as **Low**.	Not required. Enhancing the vegetation along the waterway will benefit this dwelling location by reducing the visibility of the PV arrays.
R1a	244 Birriwa Bus Route North	600 m	Topography and crops screen views of the project closest to the dwelling. There are individual, intermittent trees along a water way between the residence and development footprint that will fragment views. This residence is south of the road and the trees along it, so distant views may be available. • magnitude of change is assessed as **High**; • visual sensitivity is assessed as **Low**; and • visual impact rating assessed as low **Moderate**.	Enhancing the vegetation along the waterway will screen potential visual impacts.

Table 5.2 Dwellings within 1 km of the development footprint

Dwelling	Location	Distance to development footprint	Visual assessment	Recommended mitigation measures
R3	406 Birriwa Bus Route North	55 m	Views to the development footprint will be available to the west and south of the residence. Existing planting close to the residence will help fracture views. There are trees located within the development footprint that can be retained to screen the PV arrays. Refer to Section 5.3.2 Viewshed Analysis figure, which illustrates the screening effect of existing trees. • Magnitude of change is assessed as **High**; • visual sensitivity is assessed as **Low**; and • visual impact rating assessed as **Moderate**.	Moving the solar panels away from the residence is recommended, and accordingly, a 300 m solar panel setback has been included in the project design between the residence R3 and the PV panels. Screen planting is also proposed along the property boundary to reduce the potential visual impact. Retaining existing trees within the development footprint, near the residence, will also provide screening.
R5	591A Birriwa Bus Route South	250 m	Views from the residence to the development footprint are screened by vegetation surrounding the residence. Potential views are available to the east of the residence when trees shed their leaves. Refer to Section 5.3.4 Viewshed Analysis figure which illustrates the potential visual impact on the residence. Based on the viewshed analysis: • magnitude of change is assessed as **High**; • visual sensitivity is assessed as **Low**; and • visual impact rating assessed as **Moderate**.	Additional mitigation measures such as screen planting within the property may be considered in a separate agreement.
R7	50 Birriwa Bus Route South	910 m	The residence is located in an elevated position with potential views of the development footprint. There is a tree lined road and waterway between the residence and development footprint. Views may be available over the trees to the southern portion of the development footprint may be available. Refer to Section 5.3.5 Viewshed Analysis figure which illustrates the potential views into the site. Based on the viewshed analysis: • magnitude of change is assessed as **Moderate**; • visual sensitivity is assessed as **Moderate**; and • visual impact rating assessed as **Moderate**.	Additional mitigation measures such as screen planting within the property may be considered in a separate agreement.

Table 5.3 Dwellings between 1 km and 2 km of the development footprint

Dwelling	Location	Distance to development footprint	Visual assessment	Recommended mitigation measures
R9	3357 Castlereagh Highway	1.4 km	Existing vegetation and topography will likely screen the development footprint and road improvement works. Based site visits and the viewshed analysis: • magnitude of change is assessed as **Low**; • visual sensitivity is assessed as **Low**; and • visual impact rating assessed as **Low**.	Not required.
R10	3552 Castlereagh Highway	1.12 km	Existing vegetation and topography will likely screen the development footprint and road improvement works. Refer to Section 5.3.12.i Viewshed Analysis R10, which illustrates the potential visual impact on the residence. Based on the viewshed analysis: • magnitude of change is assessed as **Low**; • visual sensitivity is assessed as **Low**; and • visual impact rating assessed as **Low**.	Not required.
R11	261 Birriwa Bus Route North	1.78 km	Topography and existing vegetation around the residence will likely screen portions of the development footprint. Refer to Section 5.3.12.i Viewshed Analysis R11, which illustrates the potential visual impact on the residence. Based on the viewshed analysis: • magnitude of change is assessed as **High**; • visual sensitivity is assessed as **Low**; and • visual impact rating assessed as **Moderate**.	Additional mitigation measures such as screen planting within the property may be considered in a separate agreement
R12	678 Birriwa Bus Route North	1.26 km	Topography and existing vegetation at the residence will likely screen portions of the development footprint. Refer to Section 5.3.12.i Viewshed Analysis R12, which illustrates the potential visual impact on the residence. Based on the viewshed analysis: • magnitude of change is assessed as **High**; • visual sensitivity is assessed as **Low**; and • visual impact rating assessed as **Moderate**.	Additional mitigation measures such as screen planting within the property may be considered in a separate agreement

Table 5.3 Dwellings between 1 km and 2 km of the development footprint

Dwelling	Location	Distance to development footprint	Visual assessment	Recommended mitigation measures
R13	1085 Birriwa Bus Route South	1.52 km	Topography and trees along roadways will likely screen portions of the development footprint. Refer to Section 5.3.12.i Viewshed Analysis R13, which illustrates the potential visual impact on the residence. Based on site visits and the viewshed analysis: • magnitude of change is assessed as **Low**; • visual sensitivity is assessed as **Low**; and • visual impact rating assessed as **Low**.	Not required.
R14	3106 Castlereagh Highway	1.68 km	Topography and trees at residence block views to development footprint. Based on the viewshed analysis: • magnitude of change is assessed as **Low**; • visual sensitivity is assessed as **Low**; and • visual impact rating assessed as **Low**.	Not required.
R15	3142 Castlereagh Highway	1.59 km	Topography and trees at residence block views to development footprint. Based on the viewshed analysis: • magnitude of change is assessed as **Low**; • visual sensitivity is assessed as **Low**; and • visual impact rating assessed as **Low**.	Not required.
R16	3148 Castlereagh Highway	1.58 km	Topography and trees at residence block views to development footprint. Based on the viewshed analysis: • magnitude of change is assessed as **Low**; • visual sensitivity is assessed as **Low**; and • visual impact rating assessed as **Low**.	Not required.
R17	3150 Castlereagh Highway	1.56 km	Topography and trees at residence block views to development footprint. Based on the viewshed analysis: • magnitude of change is assessed as **Low**; • visual sensitivity is assessed as **Low**; and • visual impact rating assessed as **Low**.	Not required.

Table 5.3 Dwellings between 1 km and 2 km of the development footprint

Dwelling	Location	Distance to development footprint	Visual assessment	Recommended mitigation measures
R18	3151 Castlereagh Highway	1.60 km	Topography and trees at residence block views to development footprint. Refer to Section 5.3.11 Viewshed Analysis illustrating the screening effect of the topography. Based on the viewshed analysis: • magnitude of change is assessed as **Low**; • visual sensitivity is assessed as **Low**; and visual impact rating assessed as **Low**.	Not required.
R19	3156 Castlereagh Highway	1.53 km	Topography and trees at residence block views to development footprint. Based on the viewshed analysis: • magnitude of change is assessed as **Low**; • visual sensitivity is assessed as **Low**; and • visual impact rating assessed as **Low**.	Not required.
R20	3162 Castlereagh Highway	1.50 km	Topography and trees at residence block views to development footprint. Based on the viewshed analysis: • magnitude of change is assessed as **Low**; • visual sensitivity is assessed as **Low**; and • visual impact rating assessed as **Low**.	Not required.
R21	3172 Castlereagh Highway	1.46 km	Topography and trees at residence block views to development footprint. Based on the viewshed analysis: • magnitude of change is assessed as **Low**; • visual sensitivity is assessed as **Low**; and • visual impact rating assessed as **Low**.	Not required.
R22	3180 Castlereagh Highway	1.42 km	Topography and trees at residence block views to development footprint. Based on the viewshed analysis: • magnitude of change is assessed as **Low**; • visual sensitivity is assessed as **Low**; and • visual impact rating assessed as **Low**.	Not required.

Table 5.3 Dwellings between 1 km and 2 km of the development footprint

Dwelling	Location	Distance to development footprint	Visual assessment	Recommended mitigation measures
R23	3183 Castlereagh Highway	1.48 km	Topography and trees at residence block views to development footprint. Based on the viewshed analysis: • magnitude of change is assessed as **Low**; • visual sensitivity is assessed as **Low**; and • visual impact rating assessed as **Low**.	Not required.

i Viewshed analysis for selected residents

The following figures illustrate the potential viewshed impacts from nearby residences that were not directly addressed in the viewpoint analysis. These residences include R1, R1a, R5, R7, R9, R11, R12, R13 and R14–R23. R14–R23 are residences in Birriwa village and are represented by a single viewpoint analysis. The impact assessments provided in Table 5.2 and Table 5.3 above were based on these viewshed analyses.

VP1

1500

500

1000

2000

2500

3000

3500

4000

4500

5000

Option A

Option B

Legend

- Viewpoint Location
- Viewpoint Buffer (500 m increments)
- Substation/BESS Areas
- Development Footprint
- Study Area
- Contour (5 m)
- Cadastral Boundaries

Viewsheds (Terrain Visibility)

- Visible terrain (excluding project infrastructure)*

Viewsheds (Project Visibility)

- Visible project infrastructure (assumed 4.5m Dev. Footprint and 7.5 m Substation/BESS height) - bare earth surface
- Visible project infrastructure (assumed 4.5m Dev. Footprint and 7.5 m Substation/BESS height) - accounting for shielding features in the landscape (eg vegetation)

*does not consider existing vegetation.

Notes

This map is indicative and for discussion purposes only.

Locality

Project

Birriwa Solar Farm

Title

Viewshed Analysis
R1 and R1a

Drawing no.: P007

Date: 6/09/2022

0 300 600 900 1,200 m

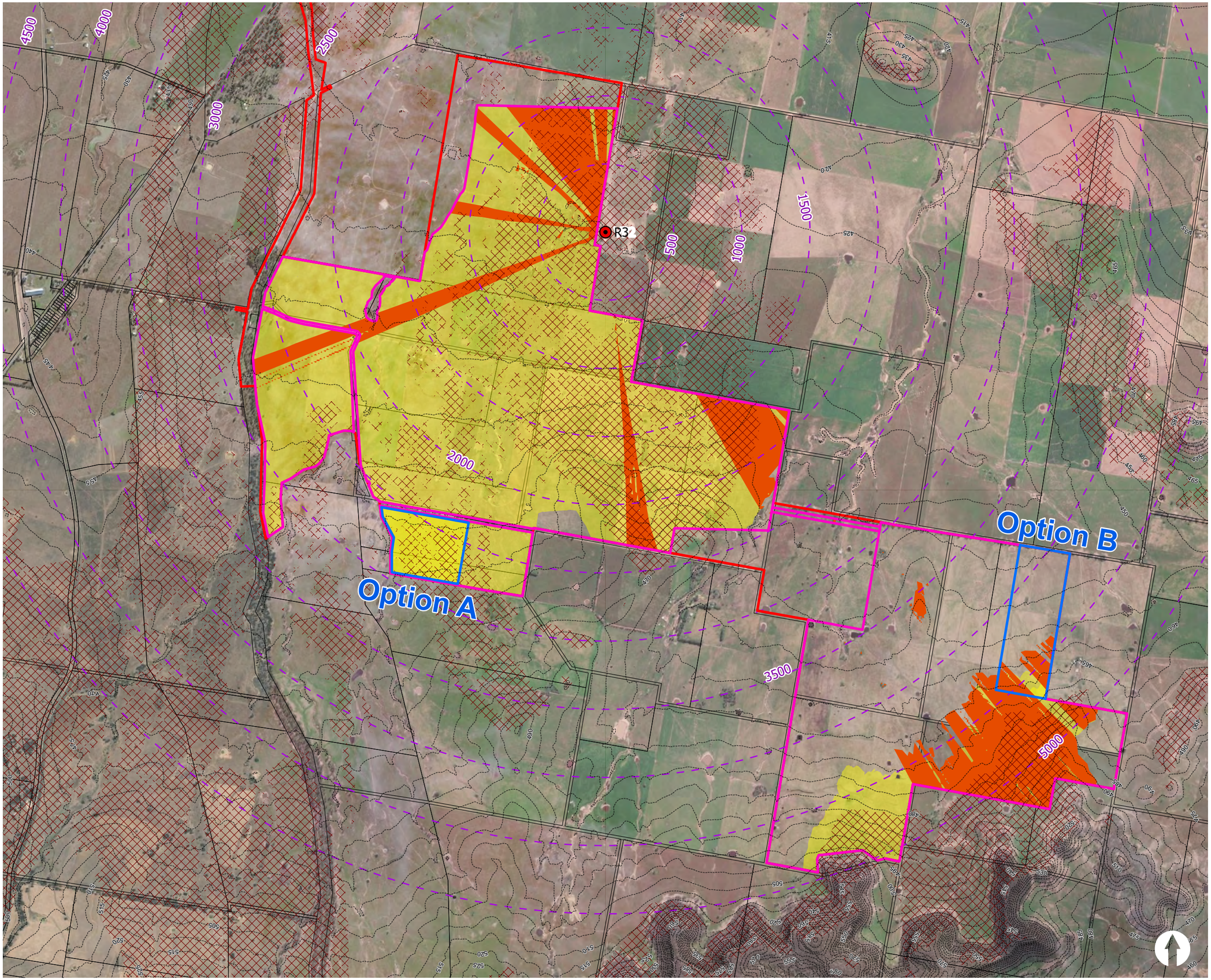
1:24,000

GDA2020 MGA Zone 55

ACEN Australia

Figure 5.4a R1 Photomontage

Figure 5.4b R1 Photomontage - post-mitigation



Legend

- Viewpoint Location
- Viewpoint Buffer (500 m increments)
- Substation/BESS Areas
- Development Footprint
- Study Area
- Contour (5 m)
- Cadastral Boundaries

Viewsheds (Terrain Visibility)

- Visible terrain (excluding project infrastructure)*

Viewsheds (Project Visibility)

- Visible project infrastructure (assumed 4.5m Dev. Footprint and 7.5 m Substation/BESS height) - bare earth surface
- Visible project infrastructure (assumed 4.5m Dev. Footprint and 7.5 m Substation/BESS height) - accounting for shielding features in the landscape (eg vegetation)

*does not consider existing vegetation.

Notes

This map is indicative and for discussion purposes only.

Locality

Project

Birriwa Solar Farm

Title

Viewshed Analysis
R3

Drawing no.	Date
P007	6/09/2022

0 330 660 990 1,320 m

1:26,000

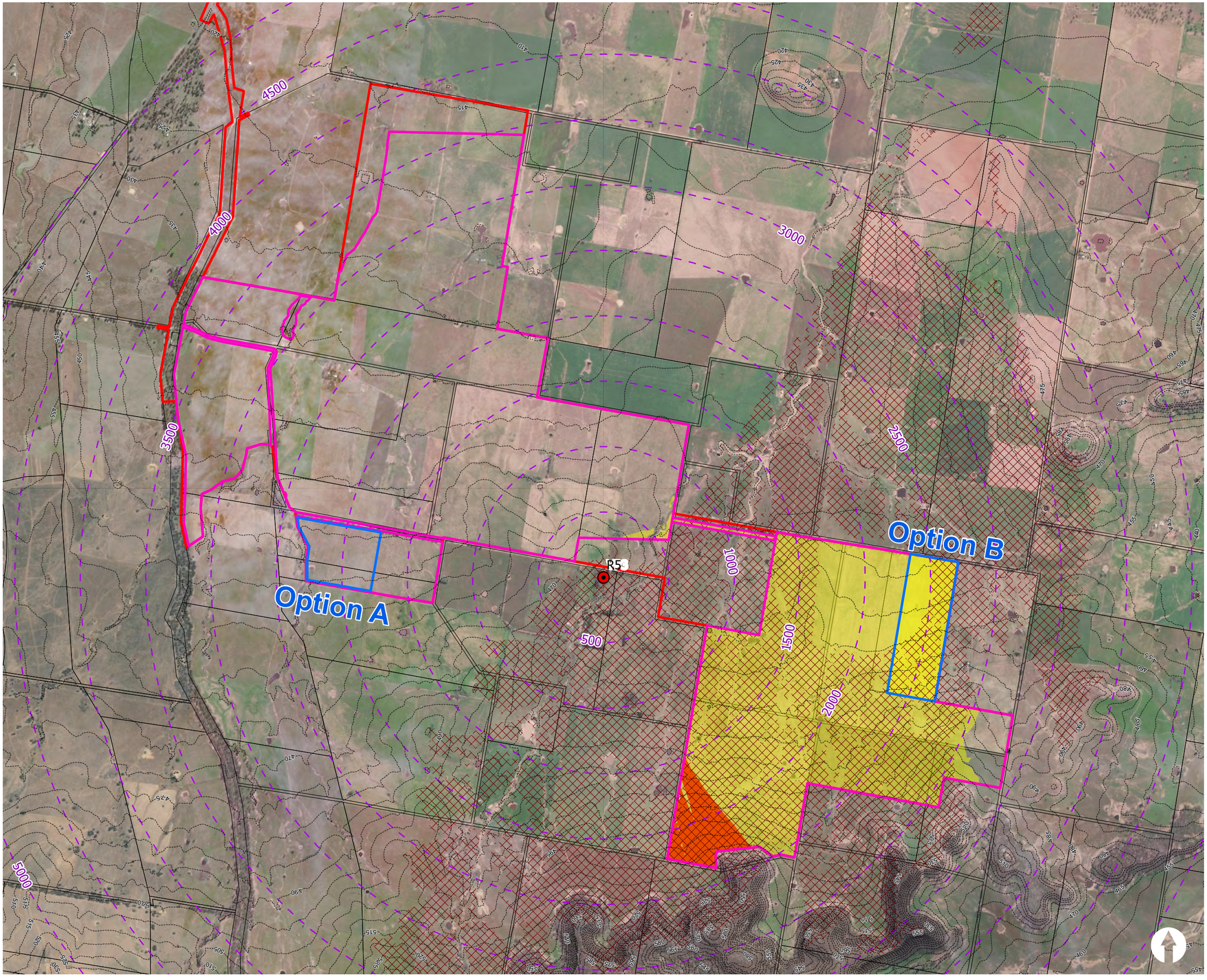
GDA2020 MGA Zone 55

ACEN Australia

Photomontage with 300 m setback for PV panels

Photomontage with 300 m setback for PV panels, and screen planting along the property boundary

Figure 5.6 R3 Photomontages



Legend

- Viewpoint Location
- Viewpoint Buffer (500 m increments)
- Substation/BESS Areas
- Development Footprint
- Study Area
- Contour (5 m)
- Cadastral Boundaries

Viewsheds (Terrain Visibility)

- Visible terrain (excluding project infrastructure)*

Viewsheds (Project Visibility)

- Visible project infrastructure (assumed 4.5m Dev. Footprint and 7.5 m Substation/BESS height) - bare earth surface
- Visible project infrastructure (assumed 4.5m Dev. Footprint and 7.5 m Substation/BESS height) - accounting for shielding features in the landscape (eg vegetation)

*does not consider existing vegetation.

Notes

This map is indicative and for discussion purposes only.

Locality

Project

Birriwa Solar Farm

Title

Viewshed Analysis
R5

Drawing no.	Date
P007	6/09/2022

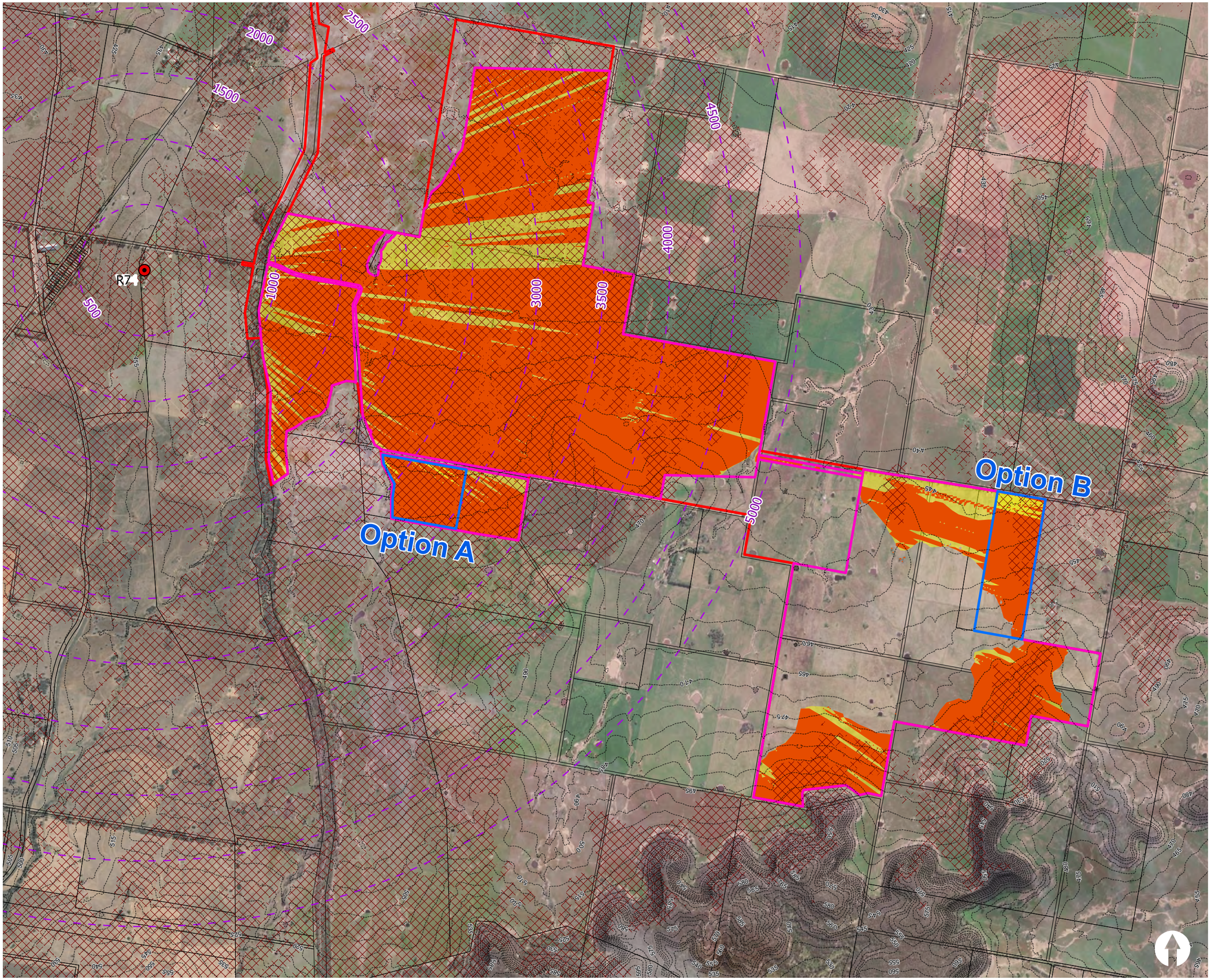
0 340 680 1,020 1,360 m

1:27,000

GDA2020 MGA Zone 55

ACEN Australia

Figure 5.8 R5 Photomontage



Legend

- Viewpoint Location
- Viewpoint Buffer (500 m increments)
- Substation/BESS Areas
- Development Footprint
- Study Area
- Contour (5 m)
- Cadastral Boundaries

Viewsheds (Terrain Visibility)

- Visible terrain (excluding project infrastructure)*

Viewsheds (Project Visibility)

- Visible project infrastructure (assumed 4.5m Dev. Footprint and 7.5 m Substation/BESS height) - bare earth surface
- Visible project infrastructure (assumed 4.5m Dev. Footprint and 7.5 m Substation/BESS height) - accounting for shielding features in the landscape (eg vegetation)

*does not consider existing vegetation.

Notes

This map is indicative and for discussion purposes only.

Locality

Project

Birriwa Solar Farm

Title

Viewshed Analysis
R7

Drawing no.	Date
P007	6/09/2022

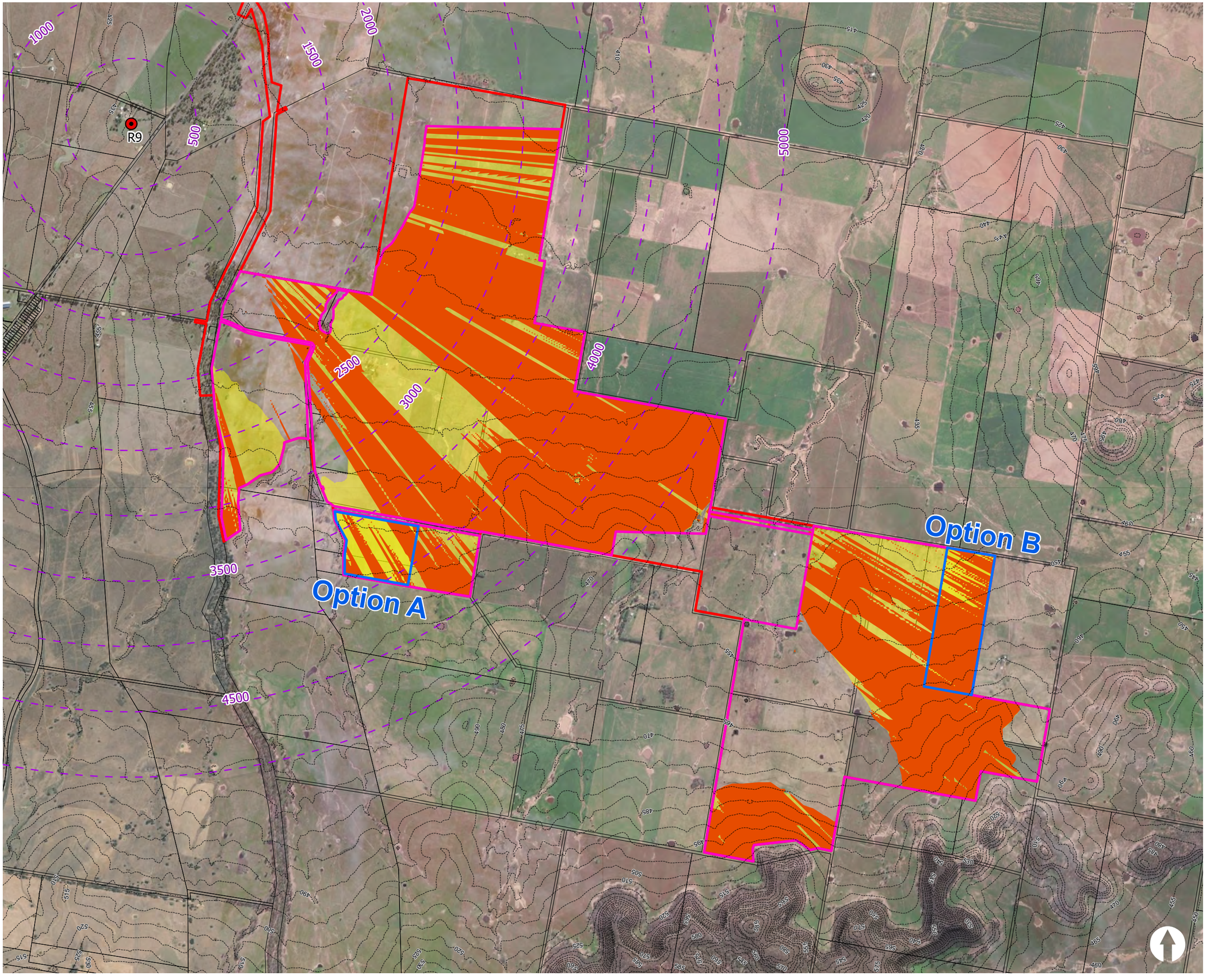
0 340 680 1,020 1,360 m

1:27,000

GDA2020 MGA Zone 55

ACEN Australia

Figure 5.10 R7 Photomontage



Legend

- Viewpoint Location
- Viewpoint Buffer (500 m increments)
- Substation/BESS Areas
- Development Footprint
- Study Area
- Contour (5 m)
- Cadastral Boundaries

Viewsheds (Terrain Visibility)

- Visible terrain (excluding project infrastructure)*

Viewsheds (Project Visibility)

- Visible project infrastructure (assumed 4.5m Dev. Footprint and 7.5 m Substation/BESS height) - bare earth surface
- Visible project infrastructure (assumed 4.5m Dev. Footprint and 7.5 m Substation/BESS height) - accounting for shielding features in the landscape (eg vegetation)

*does not consider existing vegetation.

Notes

This map is indicative and for discussion purposes only.

Locality

Project

Birriwa Solar Farm

Title

Viewshed Analysis
R9

Drawing no. P007

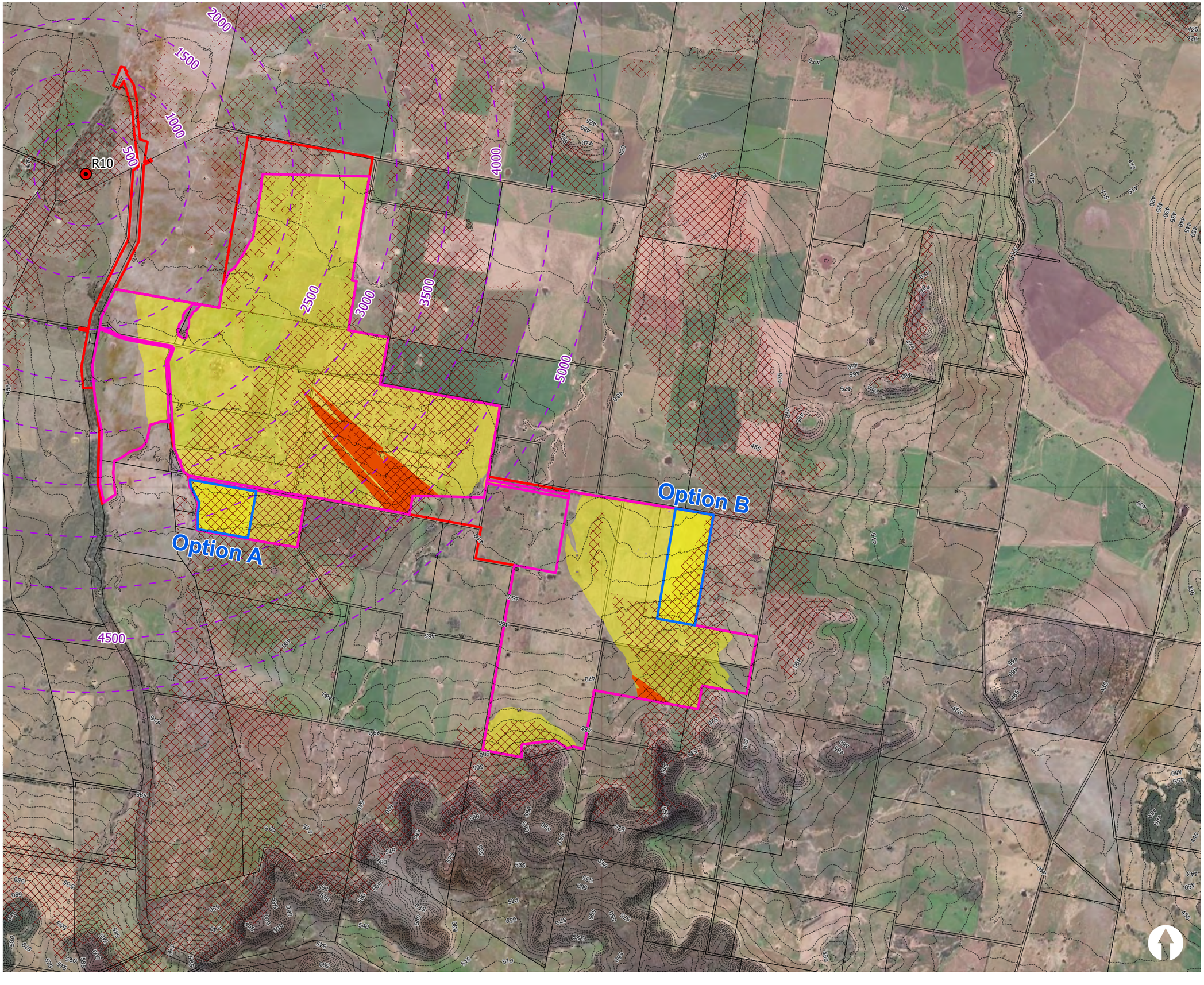
Date 6/09/2022

0 340 680 1,020 1,360 m

1:27,000

GDA2020 MGA Zone 55

ACEN Australia



Legend

- Viewpoint Location
- Viewpoint Buffer (500 m increments)
- Substation/BESS Areas
- Development Footprint
- Study Area
- Contour (5 m)
- Cadastral Boundaries

Viewsheds (Terrain Visibility)

- Visible terrain (excluding project infrastructure)*

Viewsheds (Project Visibility)

- Visible project infrastructure (assumed 4.5m Dev. Footprint and 7.5 m Substation/BESS height) - bare earth surface
- Visible project infrastructure (assumed 4.5m Dev. Footprint and 7.5 m Substation/BESS height) - accounting for shielding features in the landscape (eg vegetation)

*does not consider existing vegetation.

Notes

This map is indicative and for discussion purposes only.

Locality

Project

Birriwa Solar Farm

Title

Viewshed Analysis
R10

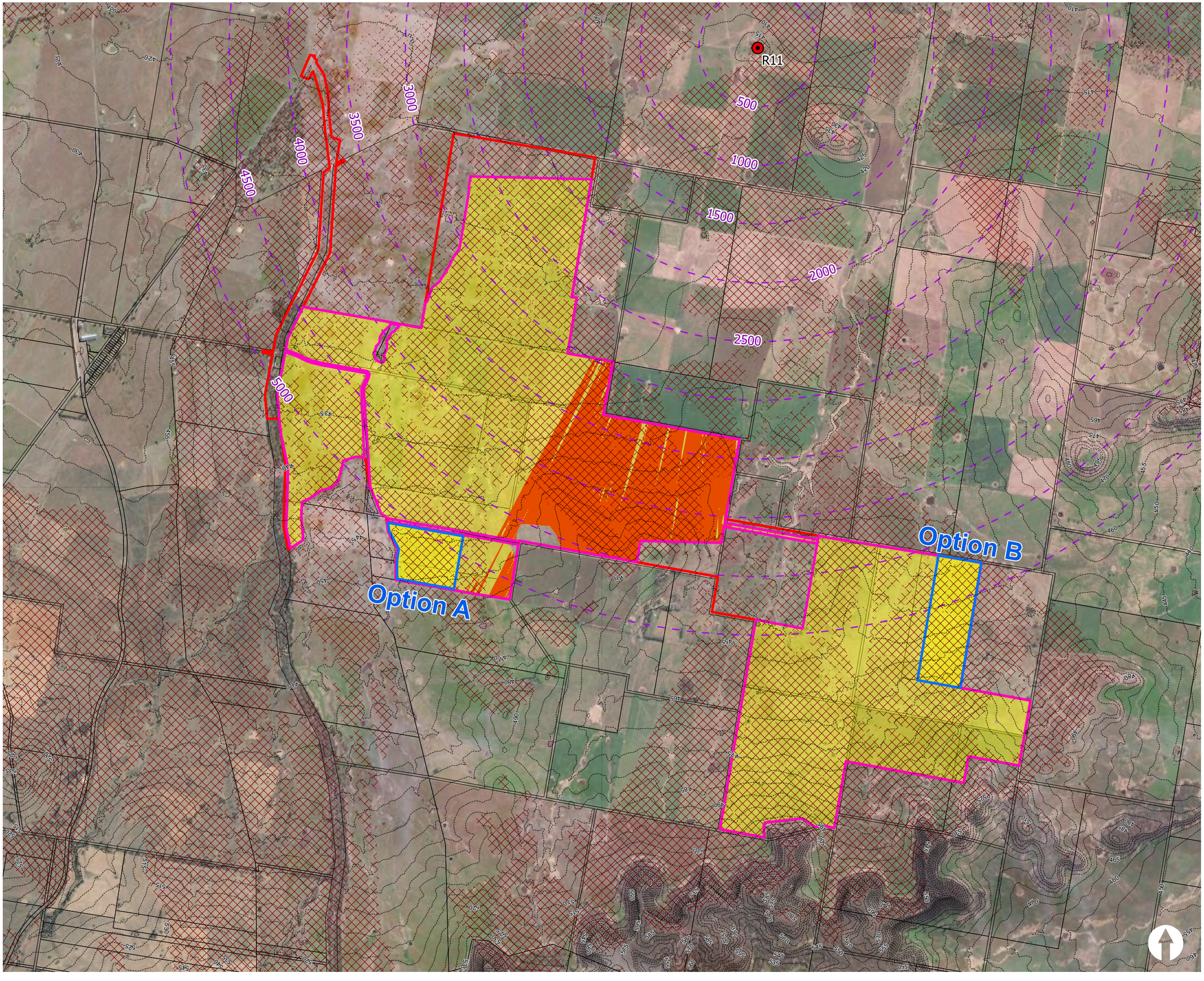
Drawing no.: P007
Date: 6/09/2022

0 430 860 1,290 1,720 m

1:34,000

GDA2020 MGA Zone 55

ACEN Australia



Legend

- Viewpoint Location
- Viewpoint Buffer (500 m increments)
- Substation/BESS Areas
- Development Footprint
- Study Area
- Contour (5 m)
- Cadastral Boundaries

Viewsheds (Terrain Visibility)

- Visible terrain (excluding project infrastructure)*

Viewsheds (Project Visibility)

- Visible project infrastructure (assumed 4.5m Dev. Footprint and 7.5 m Substation/BESS height) - bare earth surface
- Visible project infrastructure (assumed 4.5m Dev. Footprint and 7.5 m Substation/BESS height) - accounting for shielding features in the landscape (eg vegetation)

*does not consider existing vegetation.

Notes

This map is indicative and for discussion purposes only.

Locality

Project

Birriwa Solar Farm

Title

Viewshed Analysis
R11

Drawing no.: P007

Date: 6/09/2022

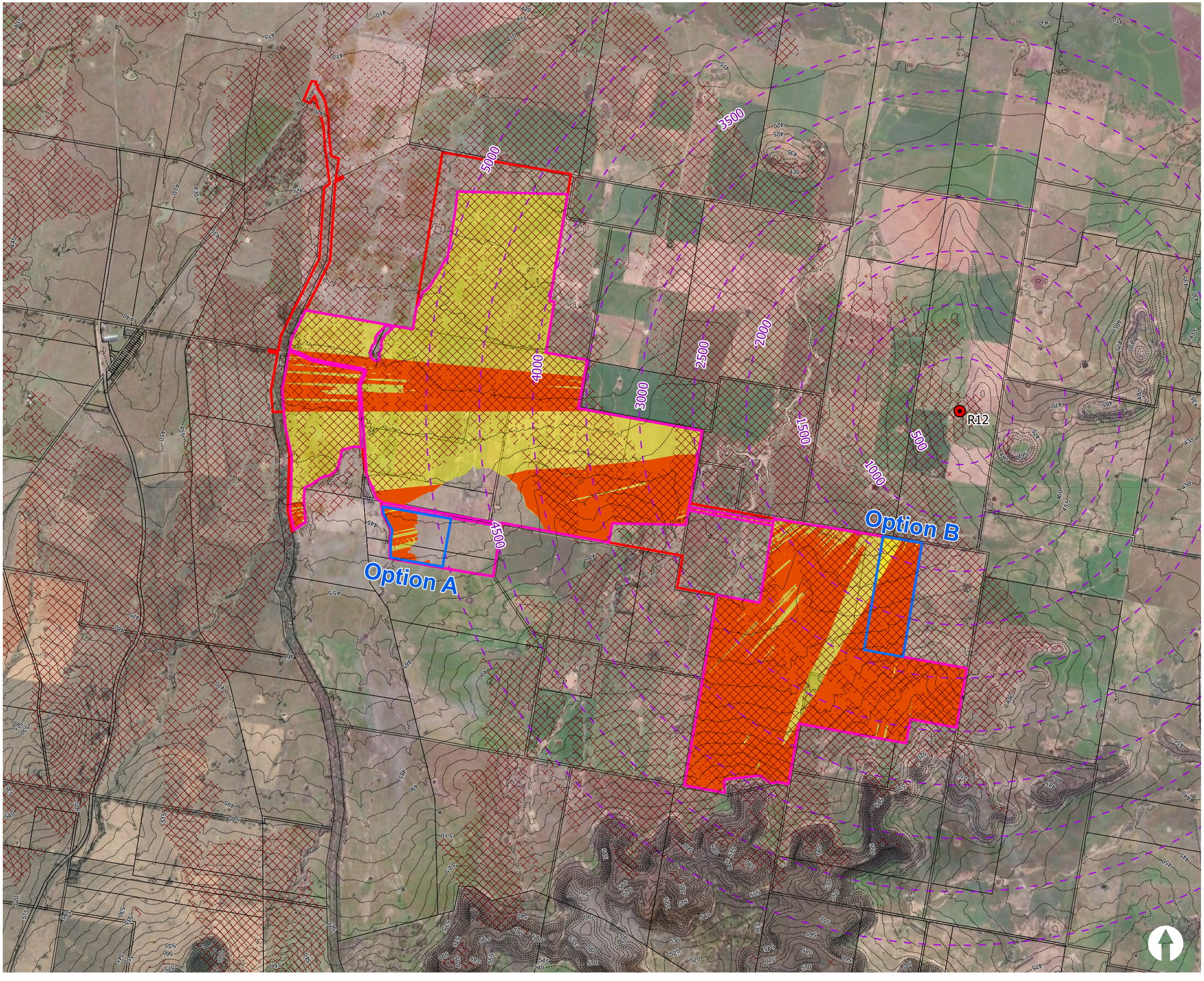
0 380 760 1,140 1,520 m

1:30,000

GDA2020 MGA Zone 55

ACEN Australia

Figure 5.14 R11 Photomontage



Legend

- Viewpoint Location
- Viewpoint Buffer (500 m increments)
- Substation/BESS Areas
- Development Footprint
- Study Area
- Contour (5 m)
- Cadastral Boundaries

Viewsheds (Terrain Visibility)

- Visible terrain (excluding project infrastructure)*

Viewsheds (Project Visibility)

- Visible project infrastructure (assumed 4.5m Dev. Footprint and 7.5 m Substation/BESS height) - bare earth surface
- Visible project infrastructure (assumed 4.5m Dev. Footprint and 7.5 m Substation/BESS height) - accounting for shielding features in the landscape (eg vegetation)

*does not consider existing vegetation.

Notes

This map is indicative and for discussion purposes only.

Locality

Project

Birriwa Solar Farm

Title

Viewshed Analysis
R12

Drawing no.: P007

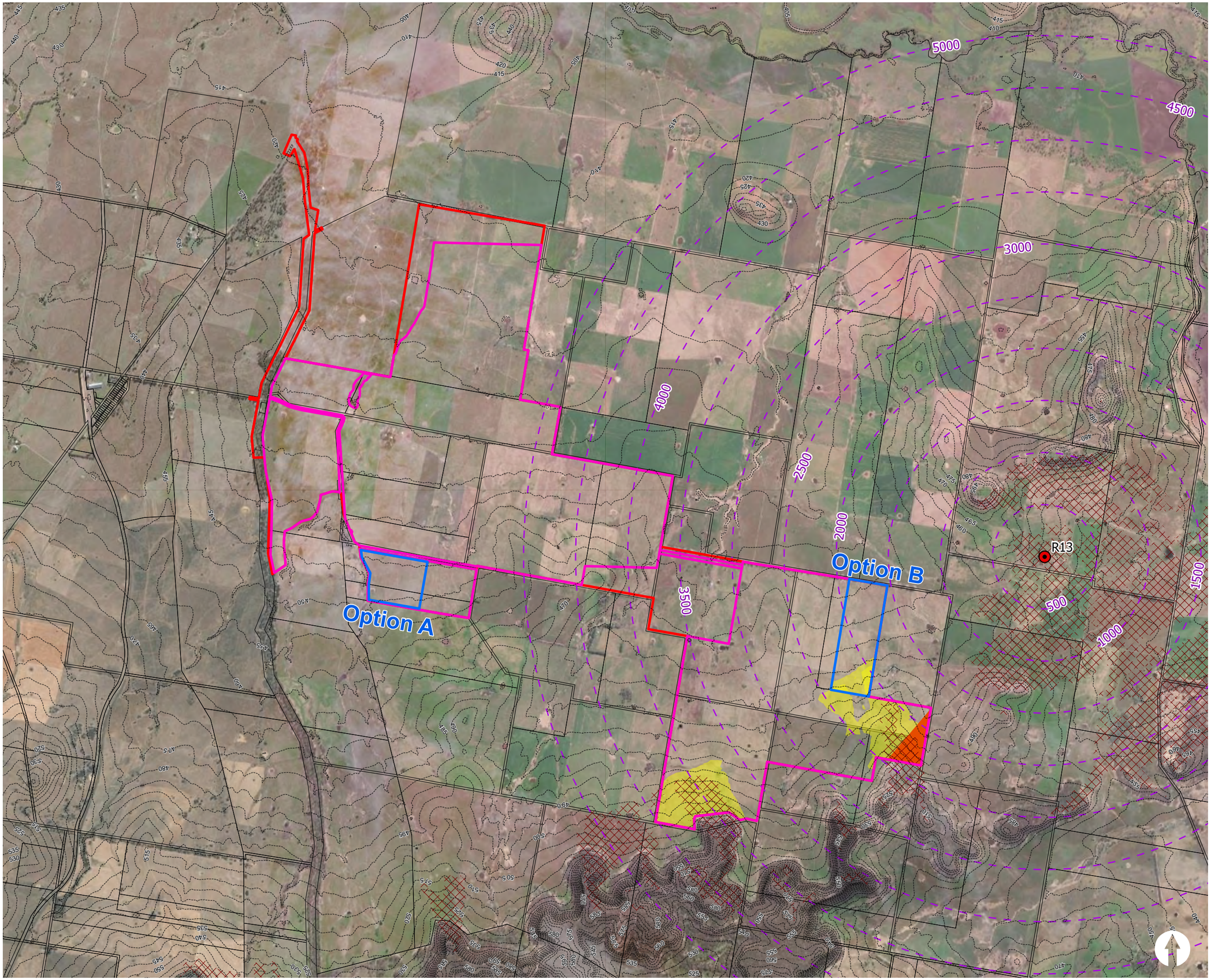
Date: 6/09/2022

0 420 840 1,260 1,680 m

1:33,000

GDA2020 MGA Zone 55

ACEN Australia



Legend

- Viewpoint Location
- Viewpoint Buffer (500 m increments)
- Substation/BESS Areas
- Development Footprint
- Study Area
- Contour (5 m)
- Cadastral Boundaries

Viewsheds (Terrain Visibility)

- Visible terrain (excluding project infrastructure)*

Viewsheds (Project Visibility)

- Visible project infrastructure (assumed 4.5m Dev. Footprint and 7.5 m Substation/BESS height) - bare earth surface
- Visible project infrastructure (assumed 4.5m Dev. Footprint and 7.5 m Substation/BESS height) - accounting for shielding features in the landscape (eg vegetation)

*does not consider existing vegetation.

Notes

This map is indicative and for discussion purposes only.

Locality

Project

Birriwa Solar Farm

Title

Viewshed Analysis
R13

Drawing no. P007

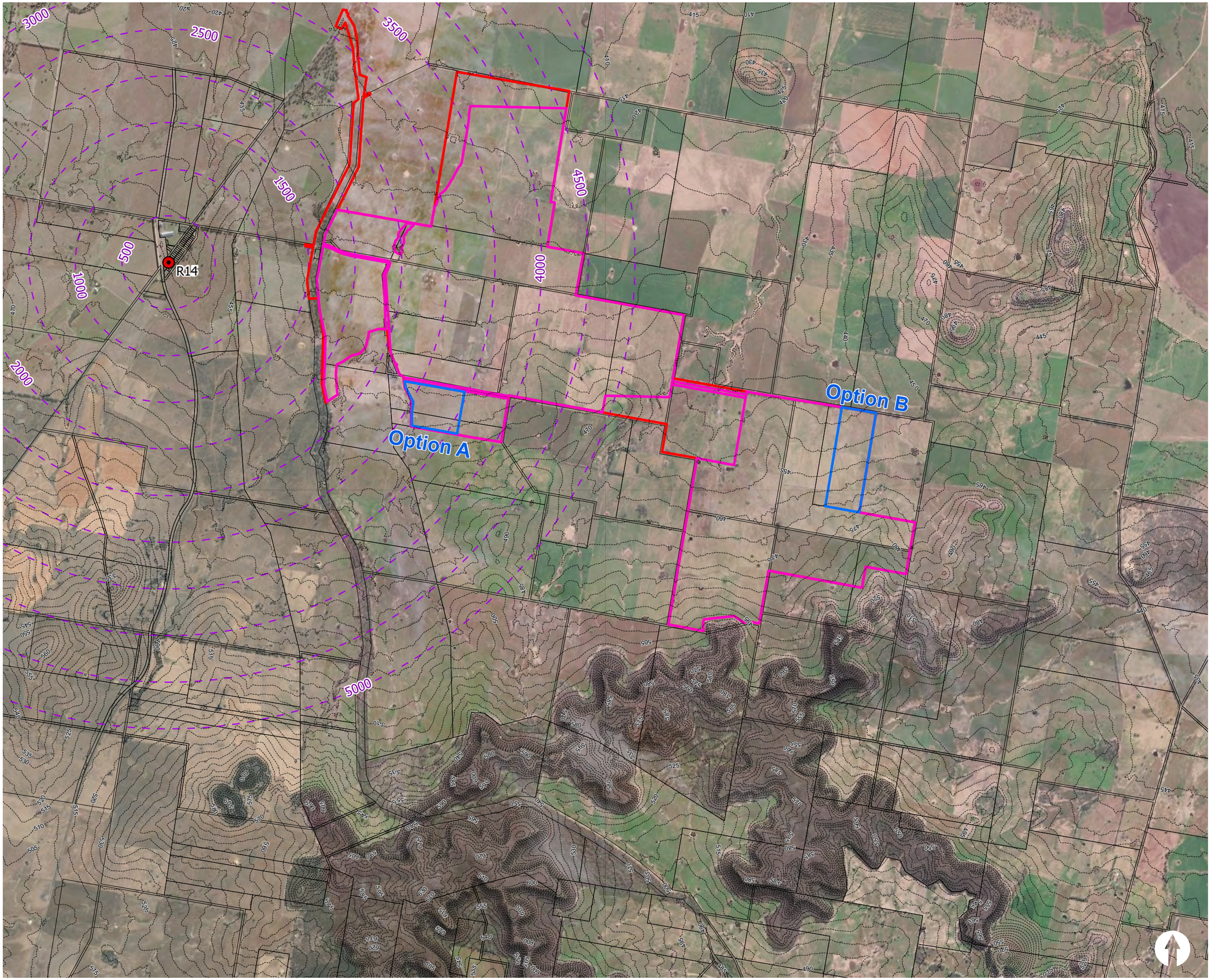
Date 6/09/2022

0 430 860 1,290 1,720 m

1:34,000

GDA2020 MGA Zone 55

ACEN Australia



Legend

- Viewpoint Location
- Viewpoint Buffer (500 m increments)
- Substation/BESS Areas
- Development Footprint
- Study Area
- Contour (5 m)
- Cadastral Boundaries

Viewsheds (Terrain Visibility)

- Visible terrain (excluding project infrastructure)*

Viewsheds (Project Visibility)

- Visible project infrastructure (assumed 4.5m Dev. Footprint and 7.5 m Substation/BESS height) - bare earth surface
- Visible project infrastructure (assumed 4.5m Dev. Footprint and 7.5 m Substation/BESS height) - accounting for shielding features in the landscape (eg vegetation)

*does not consider existing vegetation.

Notes

This map is indicative and for discussion purposes only.

Locality

Project

Birriwa Solar Farm

Title

Viewshed Analysis
R14-R23

Drawing no.	Date
P007	6/09/2022

0 490 980 1,470 1,960 m

1:38,000

GDA2020 MGA Zone 55

ACEN Australia

5.4 Reflectivity and glare

The potential impacts of sunlight reflecting off the proposed solar project elements are glint and glare impacts. When sunlight is reflected off a smooth surface, it can result in glint or glare. Glint refers to short periods and more intense levels of exposure, while glare refers to sustained or continuous periods of exposure to excessive brightness, but at a reduced level of intensity (Morelli 2014). Glint is a quick reflection or flash of light, while glare is experience for a longer period of time. Both of these can be annoying and dangerous in certain situations by causing momentary blindness.

Reflection in the form of glint and glare will only be possible when direct sunlight occurs. Therefore, in those instances where glint and glare from the project elements may occur, people will also likely experience direct sunlight, which will be a significantly brighter and more intense source of light than reflections. Nonetheless, glint and glare may result from the project and may have an impact on receptors, primarily dwellings within proximity of the development, motorists travelling along the local road network.

5.4.1 Reflectivity

Generally, the light reflected is diminished by first hitting the substrate that reflected it. Since solar cells are designed to absorb light energy to create electrical currents, they will only reflect a portion of the sunlight that falls on them.

Typically, solar panels are constructed from a treated glass that is designed to minimise reflection and maximise the amount of light transmitted through the glass to the receptor. Typical treated glass that is used for solar cells reflects about 4% of the light that hits the cell. This is equivalent to a water body (pond or lake), which is considered to be a fairly low amount of reflection.

5.4.2 Angle of reflection

The angle of reflection of light off a reflective surface is directly related to the angle of incidence of the light from the source. In the case of a PV array, the sunlight will reflect off the panel at the same angle as it arrives from the sun. If the panel is stationary, the sun's angle relative to the solar panel will vary by time of day and therefore reflect toward the west in the morning and eastward in the evening.

The solar arrays proposed for this solar project will track the sun's movement across the sky. This means the solar panels will be perpendicular to the incoming sun rays. The tracking system will not allow the solar panels to exceed 60^{o} from the horizon line. As a result, reflections will be directed upward and away from any ground-based viewers. Geometrically, the lowest angle of reflection will be 30^{o} above the horizon line.

The seasonal change of the sun's movements will vary the refection angles as well. As the sun move southward in the summer months, the reflection will move northward, and vice versa in the winter months (when the sun is north of the equator). While this movement changes the reflection angle in a north-south direction, the reflection angle will not fall below 30^{o} above the horizon line.

5.4.3 Analysis

By knowing the characteristics of reflected light, we can determine where glare is likely to be an issue. In the case of the Birriwa Solar and Battery project, trackers will be used to maximise the sunlight absorbed by the cells. The trackers are designed to keep the panel perpendicular to the sun. We can therefore assume that the sunlight reflected will reflect perpendicular to the cell and directly back toward the sun. At times when the tracking system has reached the limit of its tracking range, the angle of incidence moves from perpendicular and the light that is reflected is expected to reflect up and away from the ground. Given that the tracking stops when the panel is 60^{o} from horizontal, the refection will be at a minimum of 30^{o} above the horizon.

i ForgeSolar Glare Analysis

The glare analysis was performed using specialised software (ForgeSolar). The calculations were based on the solar array properties outlined in Section 2. Further parameters include:

- PV cells extend to 4.5 m above ground level with solar glass that has an anti-reflection surface treatment; and
- single axis tracking rotation aligned on a north-south axis (9^0 east of north), with a range of +/- 60^0 from vertical.

An assumption has been made that once the panels reach their maximum tracking angle, they remain in this position until the sun has set. It is further noted that the most conservative assumption has been made for the height of the solar panels from the ground level, that is 4.5 m based on the "2P" design.

Glare impacts were assessed against surrounding residence locations and travellers along Castlereagh Highway, the railway, Golden Highway, Merotherie Road, Birriwa Bus Route North and Birriwa Bus Route South (Central West Cycle Trail).

The software calculates the minutes of potential glare predicted at each location every day through the course of a year. The results indicate the number of minutes predicted at each location along with the type of glare expected. The classifications of glare from the software are:

- Green glare – glare is present with only a low potential for temporary after-image or flash blindness.
- Yellow glare – glare has a moderate potential for temporary after-image or flash blindness.
- Red glare – glare with high potential for permanent eye damage.

The glare analysis produced by the software does not account for physical obstructions between the solar arrays and the residences, motorists and cyclists. This includes the presence of buildings, trees and other structures. Therefore, a worst-case scenario is calculated.

Table 5.4 summarises the findings of the glare assessment. Refer to Appendix A for the ForgeSolar glare analysis results.

Table 5.4 Glare analysis results

Location	Location name assigned by software	Glare from solar arrays		Glare from BESS structures	
		Green glare (minutes	Yellow glare (minutes)	Green glare (minutes)	Yellow glare (minutes)
R1, R1a	OP: OP 1	0	0	17	0
R3	OP: OP 2	0	0	137	0
R5	OP: OP 3	0	0	77	0
R7	OP: OP 4	0	0	30	0
R9	OP: OP 22	0	0	35	0
R10	OP: OP 20	0	0	52	0
R11	OP: OP 5	0	0	0	0
R12	OP: OP 8	0	0	0	0

Table 5.4 Glare analysis results

Location	Location name assigned by software	Glare from solar arrays		Glare from BESS structures	
		Green glare (minutes	Yellow glare (minutes)	Green glare (minutes)	Yellow glare (minutes)
R13	OP: OP 9	0	0	0	93
R14 and Birriwa Village	OP: OP 13-19	0	0	35	0
R30	OP: OP 6	0	0	0	0
R31	OP: OP 7	0	0	0	0
Castlereagh Highway	ROUTE: Castlereagh Highway	0	0	0	0
Golden Highway	ROUTE: Golden Highway	0	0	0	0
Railway	ROUTE: Railway	0	0	209	0
Merotherie Road	ROUTE: Merotherie Rd	0	0	204	0
Birriwa Bus Route North	ROUTE: Birriwa Bus Route North	0	0	40	0
Birriwa Bus Route South (Central West Cycle Trail)	ROUTE: Birriwa Bus Route South – Cycle Trail	7872	0	5,801	14,669

Based on the glare analysis, the risk of glint and glare related impacts experienced at residences and along roads as a result of the project are limited.

The glare from the solar arrays is limited in location and intensity. As indicated in Table 5.4, there is a potential for green glare for 7,872 minutes along Birriwa Bus Route South over the course of the year. The glare is limited to approximately 400 m of the road at the top of a rise. The predicted glare occurs between 8:00 and 9:30 am during the months of April, May, July and August as well as between 1:30 pm–3:00 pm during June.

The potential glare from the BESS structures is also limited in location but is more intense. It should be noted that this estimate is conservative because both Option A and Option B locations for the BESS structures have been included in the glare analysis, whereas only one option will be chosen and installed if the project is approved and goes to construction. Further, the designs of the BESS infrastructure have yet to be finalised. Nevertheless, glare from the BESS structures is most intense along the roadway adjacent to the structures. Most of this glare is predicted to occur along Birriwa Bus Route South (Central West Cycle Trail). There is, therefore, the potential to impact residences located east of the BESS locations as well as motorists and cyclists traveling west in the morning. It should be noted that there is only one residence east of the Option A location (R5) that may be affected, and one non-associated residence east of Option B location (R13) that may be affected.

In the evening residences located west of the BESS locations will be similarly affected along with motorists and cyclists travelling east. The only non-associated residences west of the Option A location are along Castlereagh Highway and Birriwa Village, which are 2.9 km from the glare source. There is only one residence west of Option B locations that may be affected. With the refinement in the design of the BESS infrastructure and choice of location finalised, the amount of potential glare is expected to substantially decrease.

Given the parameters of reflection and the movement of the solar panels, there are limited locations surrounding the site where glint or glare from the solar arrays are geometrically possible. Based on the glare analysis, glint and glare from the project infrastructure is not expected to significantly impact the following:

- residences within the vicinity of the development footprint;
- people engaged in agricultural activities in the surrounding landscape;
- motorists travelling along the local road network; motorists travelling along a number of minor, unsealed rural property access roads and farm tracks;
- cyclists riding along the CWCT, which runs along Birriwa Bus Route South; and
- aircraft arriving at or departing from local airfields (Dunedoo, Dunedoo Hospital).

Note that users of Birriwa Bus Route South may experience low levels of glare from the solar arrays and may experience low levels of glare from the BESS enclosures.

5.5 Cumulative impacts

It is important to consider the effect of multiple projects on the visual character of the landscape. Multiple projects near each other can result in cumulative visual impacts that impact the way a landscape is experienced. Cumulative visual impacts can arise from the presence of similar projects that may have a low impact individually, but when viewed together, can have a significant visual impact on the landscape. Generally, this occurs when:

- multiple renewable energy projects are located within an area and they change perceptions of the area due to repeated exposure to similar projects – this can be referred to as 'sequential viewing' and projects do not have to be seen simultaneously; and
- simultaneous views of multiple renewable energy projects from public or private viewing locations.

Proposed, approved, under construction and operational renewable energy developments (known at the time of this EIS preparation) within, and in the vicinity of, the CWO REZ are shown on Figure 5.18 with the following developments known within 25 km of the study area.

Table 5.5 Local renewable energy projects

Project	Relative location (distance from development footprint)	Status	Cumulative impact Potential and timing
Barneys Reef Wind Farm	3.5 km and 2.4 km south to the closest wind turbine location	SEARs issued	Yes – during construction and operations. Refer to Section 5.5.2i.
Merotherie Energy Hub	3.6 km east to the proposed energy hub site	Planning stages	Non anticipated
REZ Transmission infrastructure	Final route to be determined	Planning stages	Potential impacts depending on final route
Valley of the Winds Wind Farm	9 km north-east to the closest wind turbine location	On exhibition	Yes – during construction and operations. Refer to Section 5.5.2ii.
Stubbo Solar Farm	14 km south-east	Approved	None anticipated
Tallawang Solar Farm	16 km south	SEARs issued	None anticipated
Dunedoo Solar Farm	13.5 km north-west	Approved	None anticipated
Bellambi Heights Solar Farm	21 km south	SEARs issued	None anticipated.
Beryl Solar Farm	24 km south	Operational	None anticipated
Sandy Creek Solar Farm	23 km south-west	SEARs issued	None anticipated

5.5.1 Solar farms

Stubbo Solar Farm is the nearest solar farm to the Birriwa Solar and Battery Project. It is located 14 km south of the study area. Due to the distance from the study area, visual impacts would be considered insignificant.

5.5.2 Wind farms

Due to the height of the wind turbines and the extent across the landscape, wind farms are visible from a greater distance than solar farms. Where solar farms typically assess a distance of 4 km for visual impacts, wind farms assess distances up to 8 km.

i Barneys Reef Wind Farm

Barneys Reef Wind Farm is the nearest renewable energy project and is located along the southern slopes of Barneys Reef between the Castlereagh Highway to the west and Merotherie to the east. The closest proposed turbine location is 3 km south-west of the study area on the western side of Barneys Reef. On the eastern side of Barneys Reef (Merotherie) the closest proposed wind turbine is 2.4 km from the study area.

During construction of the wind farm there is potential for cumulative visual impacts. The cumulative visual impacts during construction primarily relate to potential for concurrent views of vehicle movements and project infrastructure from both the project and Barneys Reef Wind Farm.

During operations, there is also potential for cumulative visual impacts of the project and Barneys Reef Wind Farm. According to the Barneys Reef Wind Farm Preliminary Visual Impact Assessment (Moir Landscape Architecture, 2021), the zone of visual influence for the wind farm indicates that potential views of the wind turbines extend northward to the Golden Highway, and eastward to Tucklan Road.

Along Castlereagh Highway, at least ten turbines will be visible. From this location, project infrastructure associated with the Birriwa Solar and Battery Project will also be visible (refer to Viewpoint 8).

To the east of Barneys Reef, turbines will be located as far north as the intersection of Merotherie Road and Birkalla Road. These turbines would be visible to residents within the eastern portions of the study area. Due to topography and remnant vegetation, the number of wind turbines likely to be visible while project infrastructure remains visible would be less than five turbines.

Overall, cumulative visual impacts from the project and Barneys Reef Wind Farm may occur for:

- Residents near the Birriwa Solar and Battery Project; however, the number of turbines visible combined with the viewing distances yield a low cumulative visual impact.
- Travellers along Castlereagh Highway and rail line; however, the number of turbines, distance to views of project infrastructure and the speed of travel will combine to yield a low cumulative visual impact.
- Cyclists on the Central West Cycle Trail (Merotherie Road and Birriwa Bus Route South) who would ride past the Stubbo Solar Farm, Barneys Reef Wind Farm and Birriwa Solar and Battery Project. Their experience of a sequential viewing of multiple renewable energy projects would yield a moderate cumulative visual impact.

ii Valley of the Winds Wind Farm

Valley of the Winds Wind Farm also has the potential for cumulative visual impacts as it is located approximately 9 km north of the Birriwa Solar and Battery Project. The *Valley of the Winds Landscape and Visual Impact Assessment* (Moir Landscape Architecture 2022) indicates that two to ten turbines would be visible from the Golden Highway corridor at distances between 3.5–5 km. Views of the Birriwa Solar and Battery Project are also possible along the Golden Highway.

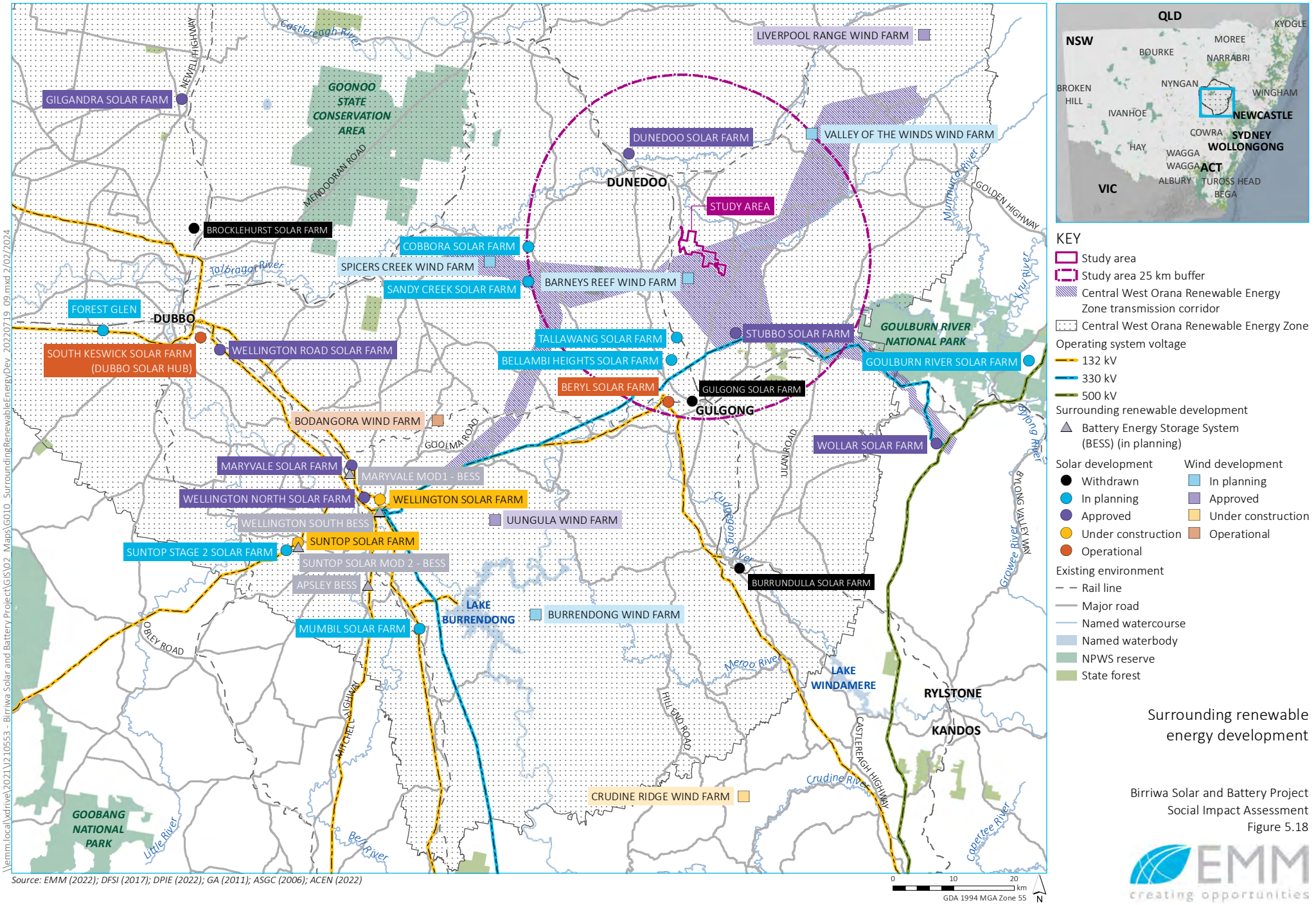
Overall, cumulative visual impacts from the project and Valley of the Winds Wind Farm may occur for:

- residents near the Birriwa Solar and Battery Project; however, the number of turbines visible combined with the viewing distances yield a low cumulative visual impact; and
- travellers along the Golden Highway; however, the number of turbines, distance to views of project infrastructure and the speed of travel will combine to yield a low cumulative visual impact.

iii Central West Orana Renewable Energy Zone

The Birriwa Solar and Battery Project is within the CWO REZ transmission corridor and is expected to be located not far from the proposed Merotherie Energy Hub. The NSW Government, via Energy Corporation NSW intends to construct several new 500 kV and 330 kV high voltage transmission lines running west to east within the vicinity of the development footprint. If constructed, the transmission towers will add additional elements to the rural landscape that, subject to the alignment, may be visible from residences, local and regional road corridors and CWCT The magnitude of change from the existing agricultural landscape will be dependent on the type of tower installed and the transmission line alignment selected during detailed design.

The locations of transmission corridors and towers is unknown at the time of writing this report. Therefore, cumulative impacts cannot be quantified at this stage.



KEY

- Study area
- Study area 25 km buffer
- Central West Orana Renewable Energy Zone transmission corridor
- Central West Orana Renewable Energy Zone

Operating system voltage

- 132 kV
- 330 kV
- 500 kV

Surrounding renewable development

- Battery Energy Storage System (BESS) (in planning)

Solar development

- Withdrawn
- In planning
- Approved
- Under construction
- Operational

Wind development

- In planning
- Approved
- Under construction
- Operational

Existing environment

- Rail line
- Major road
- Named watercourse
- Named waterbody
- NPWS reserve
- State forest

Source: EMM (2022); DFSI (2017); DPIE (2022); GA (2011); ASGC (2006); ACEN (2022)

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Surrounding renewable energy development

Birriwa Solar and Battery Project
Social Impact Assessment
Figure 5.18

EMM creating opportunities

6 Mitigation measures

A range of visual impact mitigation methods are available to screen development. As a general rule, mitigation should aim first at reducing the visible changes to the landscape. Secondly, mitigation should screen new infrastructure introduced by the project to present a landscape that is as similar to the existing landscape as possible.

Mitigation measures specific to the Birriwa Solar and Battery Project have been identified and are outlined below. The mitigation measures presented below are made notwithstanding issues raised by other environmental aspects (eg biodiversity and construction and operational noise).

6.1 Construction mitigation

The potential for the greatest visual impact occurs during the construction stages of a project. This is when the changes to the landscape occur, and there is a lot of movement of vehicles and equipment. Even though construction is viewed as temporary, practical steps should be taken to reduce the impacts during this stage. These practices include:

- locate laydown areas in areas with limited visibility from residences and public roads;
- minimise creation of dust from vehicles and wind;
- restore or remediate any earthworks undertaken during construction; and
- keep clearing and trimming of vegetation to a minimum.

6.2 PV arrays and associated infrastructure

These recommendations aim to integrate the project into the landscape with minimal changes to the landscape character of the area. They are intended to reduce the visual impact of the project based on the predicted impacts from the assessed viewpoints.

6.2.1 Design considerations

Good design principles applied to the project during the design stages can help keep the visual impacts to a minimum. This is done primarily through careful siting of project elements to take advantage of the topography and existing vegetation.

The following outlines the design considerations applied to the project:

- Use finishes and products that minimise or eliminate surface glare.
- Select finishes and colours that are appropriate to the location and context to blend the development into surroundings. The visual impact of the BESS and associated structures can be minimised by careful selection of materials and colours. Neutral colours that blend in with the surrounding landscape will be used where possible, such as khaki, green, beige, or similar.

6.2.2 Lighting

In response to the Dark Sky Guidelines, any project lighting should adhere to the following guidelines:

- minimise lighting required, and only light areas as required for safety and security;
- shield lights and orient lighting downward to eliminate any light spill;
- avoid 'over' lighting by only lighting areas that need to be lit;
- use warm white light colours;
- switch off lights when not required;
- use asymmetric beams, where floodlights are used; and
- ensure lights are not directed toward reflective surfaces.

The project will not impact on the Siding Spring Observatory provided the project lighting follows the Dark Sky Guidelines and AS 4282 Control of obtrusive effects of outdoor lighting.

6.3 Vegetation retention

The landscape character of the area consists of scattered vegetation and undulating agricultural land. The study area therefore has limited existing vegetation that can be retained. However, existing vegetation should be retained where possible to maintain existing levels of screening.

Specific areas to target for vegetation retention are:

- Road corridors, except for locations approved for modification – most of these trees may be outside of project boundaries and will be retained. However, trees within the project boundary and adjacent to roads should be considered for retention.
- Waterways – most of the waterway planting has been identified by constraints mapping and will be retained with the exception of approved crossings and modifications.

6.4 Landscaping

Using planting as a visual screen is a beneficial mitigation measure used to reduce the visibility of a solar project from a specific vantage point. It is effective in screening views from a fixed point, like a residence, or a sequence of points, like travelling along a roadway. Generally, the planted screen needs to be close to the viewing point to be effective.

Recommendations specific to the project are as follows:

- install screen planting (approximately 800 m) along the development footprint boundary at the north-west corner of the study area adjacent to Birriwa Bus Route North, R1 and R1a;
- install trees along the north side of Birriwa Bus Route South from Viewpoint 3 extending approximately 1 km west; and
- install screen planting along the property boundary at R3, approximately 350 m of screening along the boundary (PV panels are setback 300 m from residence).

Other residences that have potential visual impacts include R7, R11 and R12. These are farther away from the development but may have views into the development footprint. Additional mitigation measures such as screen planting within the property may be considered in a separate agreement with the landholders.

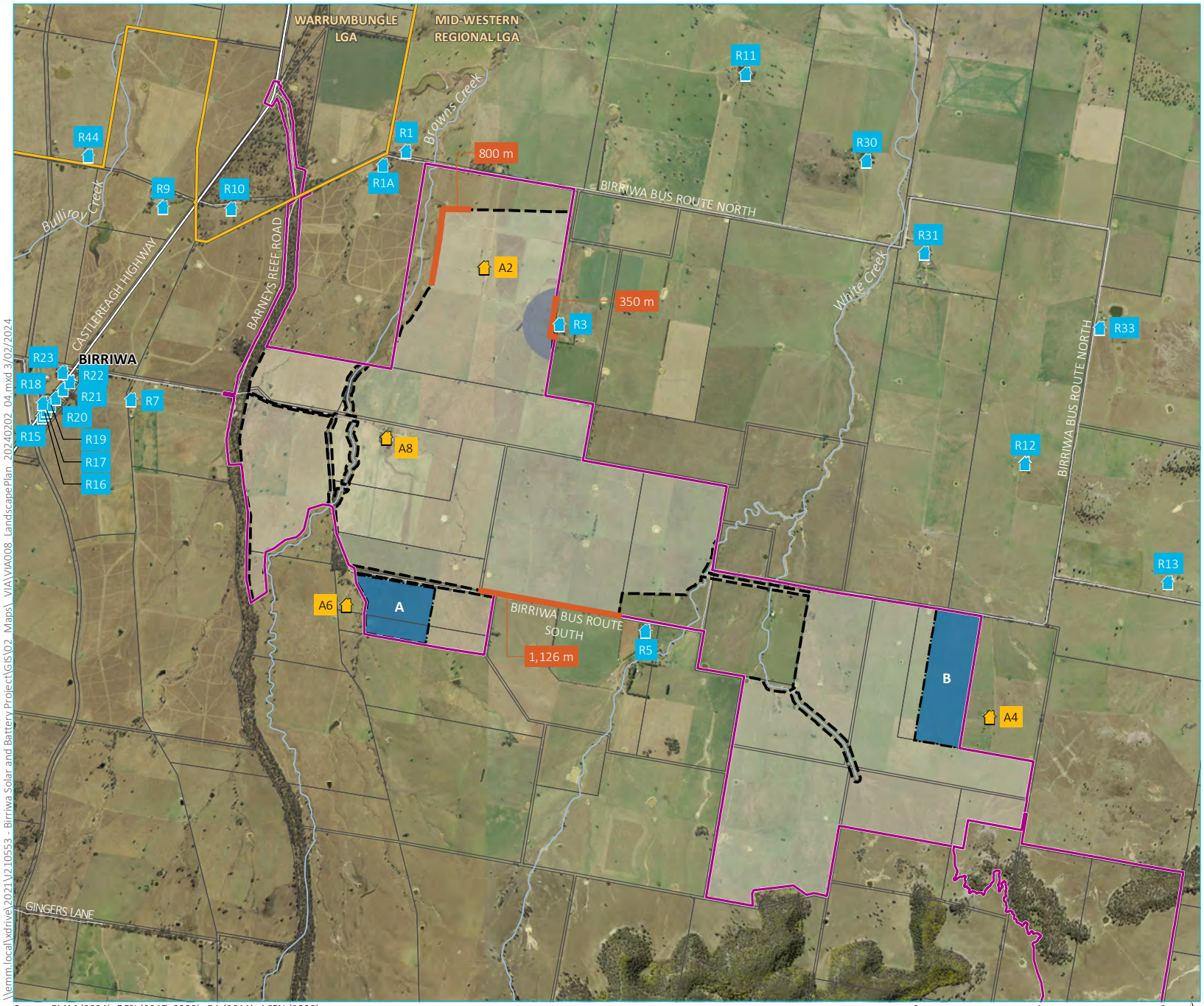
A landscape plan (Figure 6.1) has been prepared to illustrate the locations and type of screening appropriate to each location. The type of screening recommended, and shown on the landscape plan includes:

- Screen planting along development footprint boundary:
    - A band of planting 5–10 m wide along the inside of the boundary. Trees should be planted at varying heights and arranged in clusters of 3–5 trees. Clusters should be spaced at 20–30 m.
    - Shrub species should dominate the screen planting, as they will reach heights of 2–3 m quickly and form the visual screen.

Suggested plant species for the screen planting are provided in Table 6.1 below. A detailed landscape plan should be developed during the detailed design stages of The Project to provide an effective screen based on the final design and layout of the project elements.

Table 6.1 Suggested plant species

Botanical name	Common name	Potential height
Brachychiton populneus	Kurrajong	15 m
Eucalyptus macrocarpa	Grey Box	20–25 m
Eucalyptus populnea	Bimble Box	10 m
Shrub species		
Acacia implexa	Hickory Wattle	10 m
Acacia decora	Western Silver Wattle	3m
Bursaria spinosa	Blackthorn	4 m
Callistemon sieberi	River Bottlebrush	5m
Dodonea viscosa	Hopbush	3 m



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Source: EMM (2024); DFSI (2017, 2022); GA (2011); ACEN (2022)

Landscape plan

Birriwa Solar and Battery Project
Visual impact assessment
Figure 6.1

EMM
creating opportunities

6.5 Impact and mitigation summary

Table 6.2 Summary of results of visual impacts at each viewpoint

Viewpoint	Distance to study area	Representative receptors	Residential or public	Project infrastructure visible based on viewshed analysis	Magnitude of change	Visual sensitivity	Visual impact rating	Mitigation proposed Refer to Table 5.2 and Table 5.3	Visual impact rating after mitigation	Potential for cumulative impacts
Viewpoint 1	550 m	R1, R1a and Motorists	Residential and public	Yes	High	Low	**Moderate**	Screen planting along the western development footprint boundary.	**Low**	No
Viewpoint 2	50 m	R3	Residential	Yes	High	Low	**Moderate**	PV panels setback 300 m from residence. Screen planting along property boundary and vegetation retention.	**Low**	No
Viewpoint 3a	65 m	Cyclists and motorists	Public	Yes	High	Low	**Moderate**	Screen planting along Birriwa Bus Route South.	**Low**	No
Viewpoint 3b	65 m	R5, cyclists and motorists	Residential and public	Yes	High	Low	**Moderate**	Screen planting could be considered at residence depending on outcome of consultation, as part of a separate agreement.	**Low**, with screen planting implemented	No
Viewpoint 4	900 m	R7, Cyclists and motorist	Residential and public	Yes	Moderate	Low	**Low**	None	**Low** R7 remains moderate as per Table 5.2	No
Viewpoint 5	2.25 km	R11, R30, R31 and motorists	Residential and public	Yes	Moderate	Low	**Low**	None	**Low** R11 remains moderate as per Table 5.2	No

Table 6.2 Summary of results of visual impacts at each viewpoint

Viewpoint	Distance to study area	Representative receptors	Residential or public	Project infrastructure visible based on viewshed analysis	Magnitude of change	Visual sensitivity	Visual impact rating	Mitigation proposed Refer to Table 5.2 and Table 5.3	Visual impact rating after mitigation	Potential for cumulative impacts
Viewpoint 6	6.8 km	Motorists	Public	Yes	Low	Low	**Low**	None	**Low**	No
Viewpoint 7	2.5 km	R13, cyclists and Motorists	Public	Yes	Low	Low	**Low**	None	**Low**	Yes – Refer to Section 5.5.2
Viewpoint 8	3.8 km	Motorists	Public	Yes	Low	Low	**Low**	None	**Low**	Yes
Central West Cycle Trail	0.02 km	Cyclists	Public	NA	High	Low	**Moderate**	Screen planting along Birriwa Bus Route South.	**Low**	Yes – Refer to Section 5.5.2i
Birriwa village	1.6 km	R14, R15, R16, R17, R18, R19, R20, R21, R22, R23, cyclists and motorists	Residential and public	NA	NA	NA	NA	None	NA	No

7 Conclusion

7.1 Visual impact summary

A visual impact assessment is not meant to determine whether the proposal is visible or not. The objective is to determine how the proposed project will impact on the existing visual amenity and landscape character. Any potential negative impacts must be investigated to determine how it can be mitigated and reduced to an acceptable level.

The project design, development footprint and placement of the BESS has evolved to minimise or avoid visual impacts where possible. This has included revisions to the solar array layout, the BESS locations and electrical connection points for the project. Nonetheless, the development of the project will result in some changes to the landscape. Visual impacts will occur during the construction and operational stages of the project, and the visual landscape will be altered from its current state for the duration of the operation of the project.

Visual assessments have been conducted from a number of representative viewpoints surrounding the development footprint. The representative viewpoints were selected based on the following criteria:

- proximity to the development footprint;
- the location of receptors (ie dwellings) and other local features (eg Birriwa village and the Central West Cycle Trail);
- the positioning of regional and local roads and potential impacts on passing motorists;
- local topography; and
- presence of vegetation with potential to provide screening.

The representative viewpoints have been assessed to demonstrate the potential visual impacts of the project. The visual assessment determined that, of the viewpoints assessed, infrastructure may be visible to varying degrees from ten of the eleven viewpoints. Based on variable elevation and undulation in the landscape and the presence of vegetation, combined with the height of the solar arrays, the impact assessment predicts:

- a low visual impact from Viewpoints, 4, 5, 6, 7, 8 and Birriwa village;
- a moderate visual impact from Viewpoints 1, 2 (resident R3) and 3, as well as the Central West Cycle Trail; and
- there were no viewpoint locations with a high impact rating.

In addition to the viewpoint assessments, each resident within 2 km of the development footprint was assessed for visual impacts (Table 5.2 and Table 5.3). The assessment for residences predicts:

- a low visual impact from R1 (Viewpoint 1), R9, R10, R13, R14, R15, R16, R17, R18, R19, R20, R21, R22, R23;
- a moderate visual impact from R1a, R3 (Viewpoint 2), R5, R7, R11, R12; and
- no residences with a high impact rating.

Landscape screening is recommended to mitigate visual impacts at the following locations (refer to Landscape Plan, Figure 6.1):

- install screen planting along the development footprint boundary at the north-west corner of the study area adjacent to Birriwa Bus Route North, R1 and R1a;
- install trees along the north side of Birriwa Bus Route South from Viewpoint 3 extending approximately 1 km west; and
- install screen planting along the property boundary at R3, approximately 350 m of screening along the boundary.

It is also recognised that the development footprint is in close proximity to R3 (Viewpoint 2). The project design has been revised to include a 300 m solar panel setback between the residence and the PV panels. Even with the setback, a landscape screen is proposed along the property boundary at this location. Consultation will continue, and if requested, further measures at R3 will be included in the design.

The residual impact after mitigation is applied, reduces the visual impact in the following locations:

- Viewpoints 1, 2 (resident R3) and 3 (residence R5) as well as the Central West Cycle Trail reduced from moderate to low; and
- Residence R1a reduced from moderate to low.

To appropriately mitigate and minimise the visual impact on R5, the project design has been refined to include at least a 300 m buffer between the residence and the development footprint. Discussions between ACEN and the owners of R5 led to further setback with no proposed PV arrays within lot 12 on DP 750755 east of the residence, with the intention to remove any visible PV arrays within approximately 1 km of R5, to the satisfaction of the landholder. Ongoing discussions between ACEN and the owner of R5 are taking place to evaluate the need for screen planting near the residence, as recommended in this assessment.

Other residences that have potential visual impacts include R7, R11 and R12. These are farther away from the development but may have views into the development footprint. Additional mitigation measures such as screen planting within the property may be considered in a separate agreement.

7.1.1 Glare analysis

A glint and glare analysis was performed to measure the possibility of glare from the solar arrays and the project infrastructure (including BESS enclosures and sound walls). The results indicated that low levels of glare may be experienced along approximately 400 m of Birriwa Bus Route South (Central West Cycle Trail) for short periods during the winter.

The vertical walls of the BESS structures and sound walls will also reflect sunlight during the early morning and late afternoon, when the sun is low on the horizon. Most of this glare is predicted to occur along Birriwa Bus Route South (Central West Cycle Trail). There is, therefore, the potential to impact residences located east of the BESS locations as well as motorists and cyclists traveling west in the morning. It should be noted that there is only one residence east of the Option A location (R5) that may be affected, and one non-associated residence east of Option B location (R13) that may be affected.

In the evening residences located west of the BESS locations will be similarly affected along with motorists and cyclists travelling east. The only non-associated residences west of the Option A location are along Castlereagh Highway and Birriwa Village, which are 2.9 km from the glare source. There is only one residence west of Option B location (R5) that may be affected.

It should be noted that this estimate is conservative because both Option A and Option B locations for the BESS structures have been included in the glare analysis. Further, the designs of the BESS infrastructure have yet to be finalised. With the refinement in the design of the BESS infrastructure and choice of location finalised, the amount of potential glare is expected to substantially decrease.

7.1.2 Night lighting

The only lighting proposed are for security and maintenance purposes. This will primarily occur at the BESS compounds/buildings.

The night lighting would be inwardly focused and shielded so it would not result in light spill impacts to neighbouring properties or impact the Siding Spring Observatory or air traffic.

7.1.3 Cumulative impacts

Cumulative visual impacts can arise from the presence of similar projects and can have a significant visual impact on the landscape when viewed together. Within a 25 km radius, there is one operational solar farm, two approved solar farms, three solar farms in the planning stage, one wind farm in the planning stage and one wind farm on exhibition.

Anticipated cumulative impacts are summarised below:

- Barneys Reef Wind Farm:
  - low visual impact for residents near the Birriwa Solar and Battery Project;
  - low visual impact for travellers along Castlereagh Highway and rail line; and
  - moderate visual impact for travellers along the Central West Cycle Trail (Merotherie Road and Birriwa Bus Route South).
- Valley of the Winds Wind Farm:
  - low visual impact for residents near the Birriwa Solar and Battery Project; and
  - low visual impact for travellers along the Golden Highway.

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Appendix A
ForgeSolar Glare Analysis

EMM
creating opportunities

FORGESOLAR GLARE ANALYSIS

Project: **Birriwa Solar and Battery Project**
Proposed 600 MW solar project

Site configuration: **EIS - v4 No Backtracking**

Client: ACEN Australia

Created 29 Aug, 2022
Updated 29 Aug, 2022
Time-step 1 minute
Timezone offset UTC10
Site ID 74730.13158
Category 100 MW to 1 GW
DNI peaks at 1,000.0 W/m^2
Ocular transmission coefficient 0.5
Pupil diameter 0.002 m
Eye focal length 0.017 m
Sun subtended angle 9.3 mrad
Methodology V2

Summary of Results

Glare with potential for temporary after-image predicted

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy
	°	°	min	hr	min	hr	kWh
Central PV array	SA tracking	SA tracking	7,872	131.2	0	0.0	-
South - Bess PV array 5	SA tracking	SA tracking	0	0.0	0	0.0	-
Southeast Slope PV array	SA tracking	SA tracking	0	0.0	0	0.0	-
West - northern PV array 3	SA tracking	SA tracking	0	0.0	0	0.0	-
West - PV array 1	SA tracking	SA tracking	0	0.0	0	0.0	-

Vertical Surface	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
East BESS	8,499	141.7	3,652	60.9
West BESS	1,239	20.6	13,318	222.0

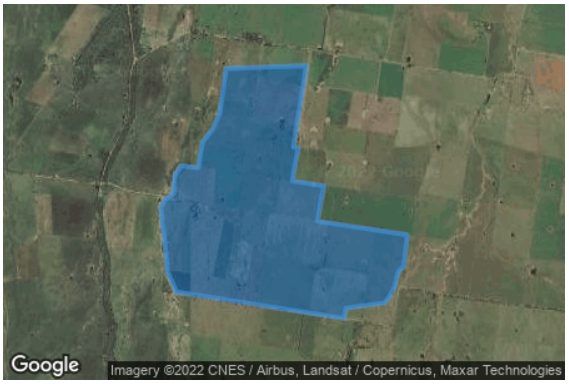
Total annual glare received by each receptor; may include duplicate times of glare from multiple reflective surfaces.

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
Birriwa Bus Route North	213	3.5	0	0.0
Birriwa Bus Route South - Cycle Trail	15,784	263.1	16,877	281.3
Castlereigh Hwy	0	0.0	0	0.0
Golden Hwy	0	0.0	0	0.0
Merotherie Rd	208	3.5	0	0.0
Railway	394	6.6	0	0.0
OP 1	34	0.6	0	0.0
OP 2	180	3.0	0	0.0
OP 3	88	1.5	0	0.0
OP 4	31	0.5	0	0.0
OP 5	0	0.0	0	0.0
OP 6	0	0.0	0	0.0
OP 7	0	0.0	0	0.0
OP 8	0	0.0	0	0.0
OP 9	11	0.2	93	1.6
OP 10	0	0.0	0	0.0
OP 11	0	0.0	0	0.0
OP 12	22	0.4	0	0.0
OP 13	45	0.8	0	0.0
OP 14	49	0.8	0	0.0
OP 15	52	0.9	0	0.0
OP 16	54	0.9	0	0.0
OP 17	58	1.0	0	0.0
OP 18	67	1.1	0	0.0
OP 19	62	1.0	0	0.0
OP 20	144	2.4	0	0.0
OP 21	0	0.0	0	0.0
OP 22	50	0.8	0	0.0
OP 23	64	1.1	0	0.0
OP 24	0	0.0	0	0.0
OP 25	0	0.0	0	0.0
OP 26	0	0.0	0	0.0
OP 27	0	0.0	0	0.0

Component Data

PV Arrays

Name: Central PV array
Axis tracking: Single-axis rotation
Backtracking: None
Tracking axis orientation: 9.0°
Tracking axis tilt: 0.0°
Tracking axis panel offset: 0.0°
Max tracking angle: 60.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

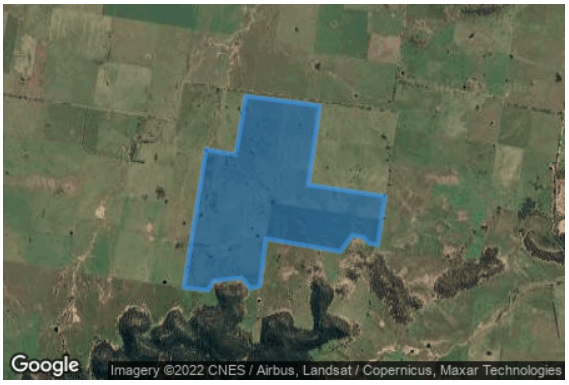


Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-32.124133	149.512306	431.31	2.50	433.81
2	-32.120026	149.513186	423.67	2.50	426.17
3	-32.119462	149.508852	423.00	2.50	425.50
4	-32.115628	149.509667	419.96	2.50	422.46
5	-32.115519	149.509002	419.16	2.50	421.66
6	-32.106086	149.510804	413.66	2.50	416.16
7	-32.106413	149.499754	416.41	2.50	418.91
8	-32.111666	149.498853	419.53	2.50	422.03
9	-32.113556	149.497801	421.77	2.50	424.27
10	-32.115028	149.496449	424.89	2.50	427.39
11	-32.117936	149.495934	424.48	2.50	426.98
12	-32.117718	149.493595	429.78	2.50	432.28
13	-32.118863	149.492673	432.04	2.50	434.54
14	-32.120953	149.492437	429.55	2.50	432.05
15	-32.121752	149.491257	430.15	2.50	432.65
16	-32.122606	149.490763	430.72	2.50	433.22
17	-32.128058	149.491493	436.33	2.50	438.83
18	-32.129857	149.491643	439.01	2.50	441.51
19	-32.132347	149.492887	444.47	2.50	446.97
20	-32.135417	149.515954	465.12	2.50	467.62
21	-32.134218	149.516212	463.08	2.50	465.58
22	-32.133618	149.521533	445.97	2.50	448.47
23	-32.132964	149.522134	444.22	2.50	446.72
24	-32.131638	149.522971	441.84	2.50	444.34
25	-32.130002	149.523422	441.74	2.50	444.24
26	-32.129385	149.524151	439.89	2.50	442.39
27	-32.125714	149.524666	435.37	2.50	437.87

Name: South - Bess PV array 5
Axis tracking: Single-axis rotation
Backtracking: None
Tracking axis orientation: 9.0°
Tracking axis tilt: 0.0°
Tracking axis panel offset: 0.0°
Max tracking angle: 60.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-32.138515	149.504442	456.29	2.50	458.79
2	-32.137843	149.499185	451.38	2.50	453.88
3	-32.133700	149.499958	445.99	2.50	448.49
4	-32.134427	149.505258	448.97	2.50	451.47

Name: Southeast Slope PV array
Axis tracking: Single-axis rotation
Backtracking: None
Tracking axis orientation: 9.0°
Tracking axis tilt: 0.0°
Tracking axis panel offset: 0.0°
Max tracking angle: 60.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material



Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-32.134580	149.542326	443.20	2.50	445.70
2	-32.133453	149.532133	441.64	2.50	444.14
3	-32.140285	149.530760	451.61	2.50	454.11
4	-32.139631	149.526683	450.44	2.50	452.94
5	-32.155655	149.523614	497.22	2.50	499.72
6	-32.155982	149.526940	501.97	2.50	504.47
7	-32.154892	149.527734	499.84	2.50	502.34
8	-32.154547	149.531596	497.33	2.50	499.83
9	-32.155783	149.532819	501.64	2.50	504.14
10	-32.155492	149.534085	490.35	2.50	492.85
11	-32.150006	149.534944	471.85	2.50	474.35
12	-32.151513	149.545136	494.78	2.50	497.28
13	-32.149606	149.546831	494.12	2.50	496.62
14	-32.149860	149.548312	493.58	2.50	496.08
15	-32.150551	149.549106	493.48	2.50	495.98
16	-32.150732	149.550286	489.25	2.50	491.75
17	-32.145100	149.551337	465.85	2.50	468.35
18	-32.143756	149.540737	462.98	2.50	465.48

Name: West - northern PV array 3
Axis tracking: Single-axis rotation
Backtracking: None
Tracking axis orientation: 9.0°
Tracking axis tilt: 0.0°
Tracking axis panel offset: 0.0°
Max tracking angle: 60.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-32.117446	149.492459	427.63	2.50	430.13
2	-32.116665	149.485271	428.47	2.50	430.97
3	-32.117719	149.484573	428.82	2.50	431.32
4	-32.118537	149.483994	431.96	2.50	434.46
5	-32.119573	149.483780	433.88	2.50	436.38
6	-32.120427	149.486354	430.17	2.50	432.67
7	-32.120936	149.490421	430.10	2.50	432.60
8	-32.120518	149.491386	429.90	2.50	432.40
9	-32.118773	149.491558	427.74	2.50	430.24

Name: West - PV array 1
Description: West
Axis tracking: Single-axis rotation
Backtracking: None
Tracking axis orientation: 9.0°
Tracking axis tilt: 0.0°
Tracking axis panel offset: 0.0°
Max tracking angle: 60.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-32.121511	149.490229	430.39	2.50	432.89
2	-32.121147	149.487397	431.31	2.50	433.81
3	-32.120348	149.484264	432.69	2.50	435.19
4	-32.122547	149.483084	435.28	2.50	437.78
5	-32.124437	149.483298	436.01	2.50	438.51
6	-32.128634	149.484285	440.14	2.50	442.64
7	-32.133341	149.484221	444.39	2.50	446.89
8	-32.134812	149.484521	447.90	2.50	450.40
9	-32.134122	149.485573	443.61	2.50	446.11
10	-32.132832	149.485337	442.86	2.50	445.36
11	-32.131560	149.485423	442.07	2.50	444.57
12	-32.129579	149.488598	438.41	2.50	440.91
13	-32.128325	149.488770	438.20	2.50	440.70
14	-32.127503	149.490502	436.96	2.50	439.46
15	-32.126340	149.490523	434.37	2.50	436.87
16	-32.122451	149.490202	430.37	2.50	432.87

Vertical Surfaces

Name: East BESS
Use smooth glass reflectivity profile? No
Custom reflectivity: 0.4
Slope error: 10.0 mrad
Lower edge height: 0 m
Upper edge height: 7 m
Surface glare contribution: evaluate single side

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)
1	-32.134407	149.542597	443.80
2	-32.143691	149.541074	462.92
3	-32.144182	149.545516	470.32
4	-32.134861	149.546932	445.95
5	-32.134407	149.542597	443.80

Name: West BESS
Use smooth glass reflectivity profile? No
Custom reflectivity: 0.4
Slope error: 10.0 mrad
Lower edge height: 0 m
Upper edge height: 7 m
Surface glare contribution: evaluate single side

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)
1	-32.137296	149.494597	449.39
2	-32.135333	149.494854	444.89
3	-32.132826	149.493545	444.83
4	-32.133680	149.499832	445.91
5	-32.137859	149.499081	451.58
6	-32.137296	149.494597	449.39

Route Receptors

Name: Birriwa Bus Route North
Path type: Two-way
Observer view angle: 50.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-32.105493	149.487436	429.13	1.20	430.33
2	-32.102294	149.494517	416.00	1.20	417.20
3	-32.102330	149.495590	415.57	1.20	416.77
4	-32.104329	149.511469	412.59	1.20	413.79
5	-32.108001	149.539235	419.73	1.20	420.93
6	-32.104402	149.539965	416.00	1.20	417.20
7	-32.106365	149.556916	422.01	1.20	423.21
8	-32.131151	149.552968	453.67	1.20	454.87

Name: Birriwa Bus Route South - Cycle Trail
Path type: Two-way
Observer view angle: 50.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-32.135369	149.575563	432.67	1.20	433.87
2	-32.134352	149.567495	436.56	1.20	437.76
3	-32.133734	149.567624	434.95	1.20	436.15
4	-32.131808	149.552818	453.05	1.20	454.25
5	-32.135151	149.552303	450.39	1.20	451.59
6	-32.135188	149.551444	448.83	1.20	450.03
7	-32.133080	149.532690	441.95	1.20	443.15
8	-32.131808	149.523678	441.76	1.20	442.96
9	-32.136423	149.522820	448.42	1.20	449.62
10	-32.135878	149.518485	459.52	1.20	460.72
11	-32.132498	149.492565	445.24	1.20	446.44
12	-32.129809	149.491277	439.17	1.20	440.37
13	-32.128973	149.491148	437.94	1.20	439.14
14	-32.127338	149.490805	436.66	1.20	437.86
15	-32.126066	149.490934	434.00	1.20	435.20
16	-32.122449	149.490505	430.52	1.20	431.72
17	-32.121432	149.491148	430.47	1.20	431.67
18	-32.121159	149.490590	430.37	1.20	431.57
19	-32.120759	149.486964	430.08	1.20	431.28
20	-32.120487	149.485913	430.46	1.20	431.66
21	-32.119778	149.483896	433.62	1.20	434.82
22	-32.119724	149.483424	435.97	1.20	437.17
23	-32.119942	149.482265	436.32	1.20	437.52
24	-32.119869	149.481814	435.55	1.20	436.75
25	-32.118342	149.469090	440.10	1.20	441.30

Name: Castlereigh Hwy
Path type: Two-way
Observer view angle: 50.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-32.163841	149.436546	562.00	1.20	563.20
2	-32.159082	149.437533	572.18	1.20	573.38
3	-32.156975	149.438134	570.68	1.20	571.88
4	-32.154613	149.439249	557.72	1.20	558.92
5	-32.151707	149.441138	541.76	1.20	542.96
6	-32.148073	149.443927	522.07	1.20	523.27
7	-32.135372	149.454427	473.26	1.20	474.46
8	-32.122179	149.465371	445.28	1.20	446.48
9	-32.105765	149.478846	430.35	1.20	431.55
10	-32.098822	149.484739	421.41	1.20	422.61
11	-32.097659	149.485211	419.45	1.20	420.65
12	-32.096459	149.485469	418.85	1.20	420.05
13	-32.091151	149.486413	415.19	1.20	416.39
14	-32.089915	149.486284	413.14	1.20	414.34
15	-32.088860	149.485984	413.16	1.20	414.36
16	-32.087879	149.485297	411.29	1.20	412.49
17	-32.085443	149.483495	409.19	1.20	410.39
18	-32.083879	149.482765	408.40	1.20	409.60
19	-32.082170	149.482422	411.00	1.20	412.20
20	-32.080461	149.482637	409.54	1.20	410.74
21	-32.078352	149.482937	407.98	1.20	409.18
22	-32.074170	149.483709	403.74	1.20	404.94
23	-32.072279	149.483838	404.14	1.20	405.34
24	-32.071406	149.483581	404.80	1.20	406.00
25	-32.054822	149.481349	408.44	1.20	409.64

Name: Golden Hwy
Path type: Two-way
Observer view angle: 50.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-32.082637	149.644314	444.29	1.20	445.49
2	-32.087400	149.634014	436.79	1.20	437.99
3	-32.088491	149.630023	435.00	1.20	436.20
4	-32.088673	149.626805	433.49	1.20	434.69
5	-32.088164	149.623071	430.00	1.20	431.20
6	-32.087037	149.618436	428.86	1.20	430.06
7	-32.086928	149.615132	428.59	1.20	429.79
8	-32.087364	149.612085	433.63	1.20	434.83
9	-32.088164	149.609295	425.41	1.20	426.61
10	-32.091472	149.597922	420.41	1.20	421.61
11	-32.091836	149.596034	419.73	1.20	420.93
12	-32.091763	149.594532	422.76	1.20	423.96
13	-32.091182	149.592429	421.34	1.20	422.54
14	-32.088091	149.584490	416.00	1.20	417.20
15	-32.085182	149.577237	414.55	1.20	415.75
16	-32.084528	149.575349	412.89	1.20	414.09
17	-32.084201	149.573203	412.99	1.20	414.19
18	-32.082601	149.561359	421.69	1.20	422.89
19	-32.081873	149.558183	447.85	1.20	449.05
20	-32.080819	149.555994	446.24	1.20	447.44
21	-32.078564	149.551488	420.85	1.20	422.05
22	-32.077522	149.548684	412.48	1.20	413.68
23	-32.072358	149.531261	413.44	1.20	414.64
24	-32.071558	149.528943	414.87	1.20	416.07
25	-32.070685	149.527699	416.68	1.20	417.88
26	-32.069122	149.526497	414.46	1.20	415.66
27	-32.059739	149.519802	412.00	1.20	413.20

Name: Merotherie Rd
Path type: Two-way
Observer view angle: 50.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-32.088881	149.584204	415.64	1.20	416.84
2	-32.098333	149.582573	414.01	1.20	415.21
3	-32.103714	149.576822	417.89	1.20	419.09
4	-32.109894	149.577509	415.68	1.20	416.88
5	-32.114401	149.574762	424.81	1.20	426.01
6	-32.119780	149.576307	424.95	1.20	426.15
7	-32.121452	149.578539	418.29	1.20	419.49
8	-32.142676	149.574934	442.43	1.20	443.63
9	-32.149725	149.574677	455.30	1.20	456.50
10	-32.152196	149.577166	448.79	1.20	449.99
11	-32.162514	149.582144	437.32	1.20	438.52
12	-32.188377	149.574419	493.97	1.20	495.17

Name: Railway
Path type: Two-way
Observer view angle: 50.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-32.079629	149.469085	419.90	2.00	421.90
2	-32.092901	149.465866	419.37	2.00	421.37
3	-32.094464	149.465480	421.96	2.00	423.96
4	-32.096500	149.465652	420.92	2.00	422.92
5	-32.106032	149.466338	430.00	2.00	432.00
6	-32.107596	149.466296	430.84	2.00	432.84
7	-32.109668	149.465952	431.14	2.00	433.14
8	-32.116174	149.464922	439.45	2.00	441.45
9	-32.118246	149.464708	444.94	2.00	446.94
10	-32.124752	149.465866	446.61	2.00	448.61
11	-32.126242	149.466596	447.49	2.00	449.49
12	-32.129186	149.468270	451.55	2.00	453.55
13	-32.135037	149.469815	460.94	2.00	462.94
14	-32.136345	149.469772	463.86	2.00	465.86
15	-32.139398	149.469343	466.39	2.00	468.39
16	-32.140415	149.469343	467.87	2.00	469.87
17	-32.142341	149.469772	471.22	2.00	473.22
18	-32.143867	149.469686	474.86	2.00	476.86
19	-32.144739	149.469257	475.61	2.00	477.61
20	-32.147428	149.467712	480.60	2.00	482.60
21	-32.148882	149.467197	483.19	2.00	485.19
22	-32.150262	149.467325	484.15	2.00	486.15
23	-32.152370	149.467025	487.48	2.00	489.48
24	-32.154368	149.466467	489.03	2.00	491.03
25	-32.157892	149.465137	496.48	2.00	498.48
26	-32.159345	149.464922	498.97	2.00	500.97
27	-32.161271	149.464450	500.80	2.00	502.80
28	-32.162543	149.463420	504.14	2.00	506.14
29	-32.165086	149.461060	508.11	2.00	510.11
30	-32.170753	149.458056	515.88	2.00	517.88
31	-32.186293	149.453222	503.73	2.00	505.73

Discrete Observation Point Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (m)	Height (m)
OP 1	1	-32.101797	149.496715	414.63	1.50
OP 2	2	-32.114193	149.510029	417.24	1.50
OP 3	3	-32.136351	149.518058	459.62	1.50
OP 4	4	-32.120451	149.473576	452.88	1.50
OP 5	5	-32.095514	149.525396	415.80	1.50
OP 6	6	-32.101767	149.535975	421.15	1.50
OP 7	7	-32.108374	149.541071	424.37	1.50
OP 8	8	-32.123548	149.550194	463.67	1.50
OP 9	9	-32.131943	149.562654	446.68	1.50
OP 10	10	-32.149345	149.452036	522.48	1.50
OP 11	11	-32.134010	149.457776	477.96	1.50
OP 12	12	-32.124073	149.457864	450.85	1.50
OP 13	13	-32.121901	149.466040	444.21	1.50
OP 14	14	-32.121610	149.466227	443.51	1.50
OP 15	15	-32.121347	149.466394	443.08	1.50
OP 16	16	-32.120988	149.466667	443.00	1.50
OP 17	17	-32.119829	149.467799	442.05	1.50
OP 18	18	-32.119171	149.468298	441.09	1.50
OP 19	19	-32.118525	149.467724	442.00	1.50
OP 20	20	-32.106564	149.481905	427.09	1.50
OP 21	21	-32.113459	149.556296	435.85	1.50
OP 22	22	-32.105971	149.475712	436.16	1.50
OP 23	23	-32.102548	149.469341	424.82	1.50
OP 24	24	-32.078316	149.487711	409.30	1.50
OP 25	25	-32.096535	149.556627	411.88	1.50
OP 26	26	-32.076119	149.514634	419.81	1.50
OP 27	27	-32.071137	149.519333	424.61	1.50

Glare Analysis Results

Summary of Results

Glare with potential for temporary after-image predicted

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy
	°	°	min	hr	min	hr	kWh
Central PV array	SA tracking	SA tracking	7,872	131.2	0	0.0	-
South - Bess PV array 5	SA tracking	SA tracking	0	0.0	0	0.0	-
Southeast Slope PV array	SA tracking	SA tracking	0	0.0	0	0.0	-
West - northern PV array 3	SA tracking	SA tracking	0	0.0	0	0.0	-
West - PV array 1	SA tracking	SA tracking	0	0.0	0	0.0	-

Vertical Surface	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
East BESS	8,499	141.7	3,652	60.9
West BESS	1,239	20.6	13,318	222.0

Total annual glare received by each receptor; may include duplicate times of glare from multiple reflective surfaces.

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
Birriwa Bus Route North	213	3.5	0	0.0
Birriwa Bus Route South - Cycle Trail	15,784	263.1	16,877	281.3
Castlereigh Hwy	0	0.0	0	0.0
Golden Hwy	0	0.0	0	0.0
Merotherie Rd	208	3.5	0	0.0
Railway	394	6.6	0	0.0
OP 1	34	0.6	0	0.0
OP 2	180	3.0	0	0.0
OP 3	88	1.5	0	0.0
OP 4	31	0.5	0	0.0
OP 5	0	0.0	0	0.0
OP 6	0	0.0	0	0.0
OP 7	0	0.0	0	0.0
OP 8	0	0.0	0	0.0
OP 9	11	0.2	93	1.6
OP 10	0	0.0	0	0.0

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 11	0	0.0	0	0.0
OP 12	22	0.4	0	0.0
OP 13	45	0.8	0	0.0
OP 14	49	0.8	0	0.0
OP 15	52	0.9	0	0.0
OP 16	54	0.9	0	0.0
OP 17	58	1.0	0	0.0
OP 18	67	1.1	0	0.0
OP 19	62	1.0	0	0.0
OP 20	144	2.4	0	0.0
OP 21	0	0.0	0	0.0
OP 22	50	0.8	0	0.0
OP 23	64	1.1	0	0.0
OP 24	0	0.0	0	0.0
OP 25	0	0.0	0	0.0
OP 26	0	0.0	0	0.0
OP 27	0	0.0	0	0.0

PV: Central PV array low potential for temporary after-image

Receptor results ordered by category of glare

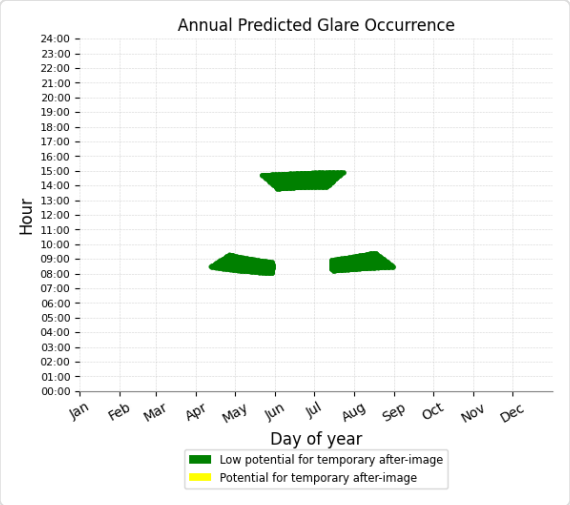
Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
Birriwa Bus Route South - Cycle Trail	7,872	131.2	0	0.0
Birriwa Bus Route North	0	0.0	0	0.0
Castlereigh Hwy	0	0.0	0	0.0
Golden Hwy	0	0.0	0	0.0
Merotherie Rd	0	0.0	0	0.0
Railway	0	0.0	0	0.0
OP 1	0	0.0	0	0.0
OP 2	0	0.0	0	0.0
OP 3	0	0.0	0	0.0
OP 4	0	0.0	0	0.0
OP 5	0	0.0	0	0.0
OP 6	0	0.0	0	0.0
OP 7	0	0.0	0	0.0
OP 8	0	0.0	0	0.0
OP 9	0	0.0	0	0.0
OP 10	0	0.0	0	0.0
OP 11	0	0.0	0	0.0
OP 12	0	0.0	0	0.0
OP 13	0	0.0	0	0.0
OP 14	0	0.0	0	0.0
OP 15	0	0.0	0	0.0
OP 16	0	0.0	0	0.0
OP 17	0	0.0	0	0.0
OP 18	0	0.0	0	0.0
OP 19	0	0.0	0	0.0
OP 20	0	0.0	0	0.0
OP 21	0	0.0	0	0.0
OP 22	0	0.0	0	0.0
OP 23	0	0.0	0	0.0
OP 24	0	0.0	0	0.0
OP 25	0	0.0	0	0.0
OP 26	0	0.0	0	0.0
OP 27	0	0.0	0	0.0

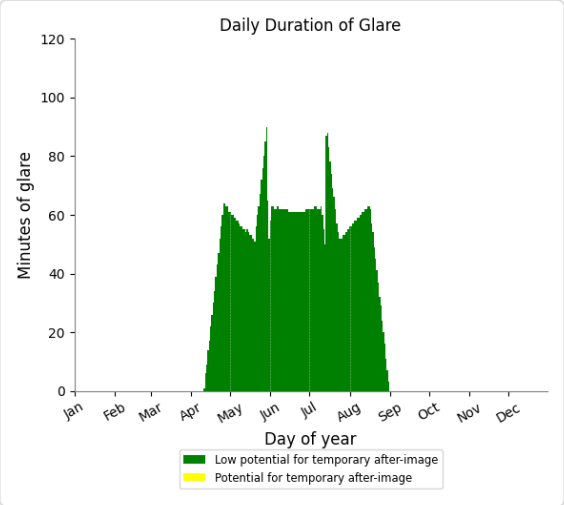
Central PV array and Birriwa Bus Route South - Cycle Trail

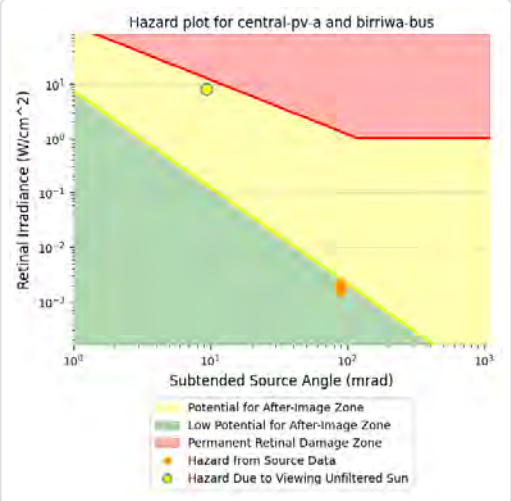
Receptor type: Route

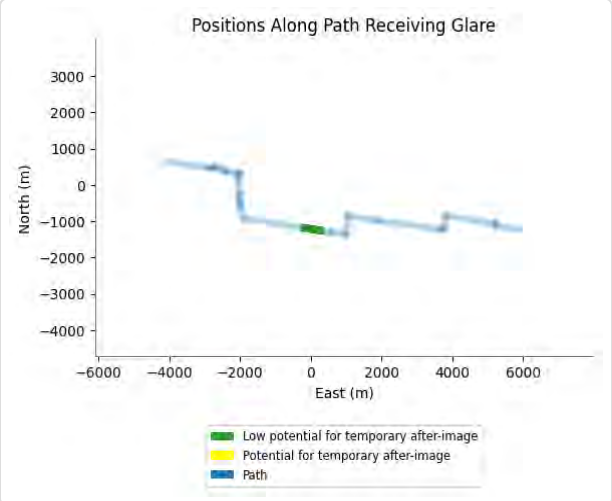
0 minutes of yellow glare

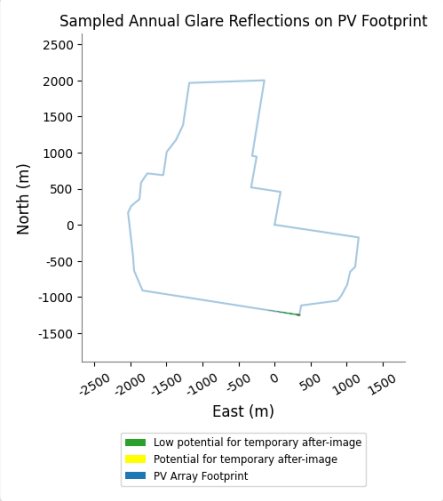
7,872 minutes of green glare











Central PV array and Birriwa Bus Route North

Receptor type: Route
No glare found

Central PV array and Castlereigh Hwy

Receptor type: Route
No glare found

Central PV array and Golden Hwy

Receptor type: Route
No glare found

Central PV array and Merotherie Rd

Receptor type: Route
No glare found

Central PV array and Railway

Receptor type: Route
No glare found

Central PV array and OP 1

Receptor type: Observation Point
No glare found

Central PV array and OP 2

Receptor type: Observation Point
No glare found

Central PV array and OP 3

Receptor type: Observation Point
No glare found

Central PV array and OP 4

Receptor type: Observation Point
No glare found

Central PV array and OP 5

Receptor type: Observation Point
No glare found

Central PV array and OP 6

Receptor type: Observation Point
No glare found

Central PV array and OP 7

Receptor type: Observation Point
No glare found

Central PV array and OP 8

Receptor type: Observation Point
No glare found

Central PV array and OP 9

Receptor type: Observation Point
No glare found

Central PV array and OP 10

Receptor type: Observation Point
No glare found

Central PV array and OP 11

Receptor type: Observation Point
No glare found

Central PV array and OP 12

Receptor type: Observation Point
No glare found

Central PV array and OP 13

Receptor type: Observation Point
No glare found

Central PV array and OP 14

Receptor type: Observation Point
No glare found

Central PV array and OP 15

Receptor type: Observation Point
No glare found

Central PV array and OP 16

Receptor type: Observation Point
No glare found

Central PV array and OP 17

Receptor type: Observation Point
No glare found

Central PV array and OP 18

Receptor type: Observation Point
No glare found

Central PV array and OP 19

Receptor type: Observation Point
No glare found

Central PV array and OP 20

Receptor type: Observation Point
No glare found

Central PV array and OP 21

Receptor type: Observation Point
No glare found

Central PV array and OP 22

Receptor type: Observation Point
No glare found

Central PV array and OP 23

Receptor type: Observation Point
No glare found

Central PV array and OP 24

Receptor type: Observation Point
No glare found

Central PV array and OP 25

Receptor type: Observation Point
No glare found

Central PV array and OP 26

Receptor type: Observation Point
No glare found

Central PV array and OP 27

Receptor type: Observation Point
No glare found

PV: South - Bess PV array 5 no glare found

Receptor results ordered by category of glare

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
Birriwa Bus Route North	0	0.0	0	0.0
Birriwa Bus Route South - Cycle Trail	0	0.0	0	0.0
Castlereigh Hwy	0	0.0	0	0.0
Golden Hwy	0	0.0	0	0.0
Merotherie Rd	0	0.0	0	0.0
Railway	0	0.0	0	0.0
OP 1	0	0.0	0	0.0
OP 2	0	0.0	0	0.0
OP 3	0	0.0	0	0.0
OP 4	0	0.0	0	0.0
OP 5	0	0.0	0	0.0
OP 6	0	0.0	0	0.0
OP 7	0	0.0	0	0.0
OP 8	0	0.0	0	0.0
OP 9	0	0.0	0	0.0
OP 10	0	0.0	0	0.0
OP 11	0	0.0	0	0.0
OP 12	0	0.0	0	0.0
OP 13	0	0.0	0	0.0
OP 14	0	0.0	0	0.0
OP 15	0	0.0	0	0.0
OP 16	0	0.0	0	0.0
OP 17	0	0.0	0	0.0
OP 18	0	0.0	0	0.0
OP 19	0	0.0	0	0.0
OP 20	0	0.0	0	0.0
OP 21	0	0.0	0	0.0
OP 22	0	0.0	0	0.0
OP 23	0	0.0	0	0.0
OP 24	0	0.0	0	0.0
OP 25	0	0.0	0	0.0
OP 26	0	0.0	0	0.0
OP 27	0	0.0	0	0.0

South - Bess PV array 5 and Birriwa Bus Route North

Receptor type: Route
No glare found

South - Bess PV array 5 and Birriwa Bus Route South - Cycle Trail

Receptor type: Route
No glare found

South - Bess PV array 5 and Castlereigh Hwy

Receptor type: Route
No glare found

South - Bess PV array 5 and Golden Hwy

Receptor type: Route
No glare found

South - Bess PV array 5 and Merotherie Rd

Receptor type: Route
No glare found

South - Bess PV array 5 and Railway

Receptor type: Route
No glare found

South - Bess PV array 5 and OP 1

Receptor type: Observation Point
No glare found

South - Bess PV array 5 and OP 2

Receptor type: Observation Point
No glare found

South - Bess PV array 5 and OP 3

Receptor type: Observation Point
No glare found

South - Bess PV array 5 and OP 4

Receptor type: Observation Point
No glare found

South - Bess PV array 5 and OP 5

Receptor type: Observation Point
No glare found

South - Bess PV array 5 and OP 6

Receptor type: Observation Point
No glare found

South - Bess PV array 5 and OP 7

Receptor type: Observation Point
No glare found

South - Bess PV array 5 and OP 8

Receptor type: Observation Point
No glare found

South - Bess PV array 5 and OP 9

Receptor type: Observation Point
No glare found

South - Bess PV array 5 and OP 10

Receptor type: Observation Point
No glare found

South - Bess PV array 5 and OP 11

Receptor type: Observation Point
No glare found

South - Bess PV array 5 and OP 12

Receptor type: Observation Point
No glare found

South - Bess PV array 5 and OP 13

Receptor type: Observation Point
No glare found

South - Bess PV array 5 and OP 14

Receptor type: Observation Point
No glare found

South - Bess PV array 5 and OP 15

Receptor type: Observation Point
No glare found

South - Bess PV array 5 and OP 16

Receptor type: Observation Point
No glare found

South - Bess PV array 5 and OP 17

Receptor type: Observation Point
No glare found

South - Bess PV array 5 and OP 18

Receptor type: Observation Point
No glare found

South - Bess PV array 5 and OP 19

Receptor type: Observation Point
No glare found

South - Bess PV array 5 and OP 20

Receptor type: Observation Point
No glare found

South - Bess PV array 5 and OP 21

Receptor type: Observation Point
No glare found

South - Bess PV array 5 and OP 22

Receptor type: Observation Point
No glare found

South - Bess PV array 5 and OP 23

Receptor type: Observation Point
No glare found

South - Bess PV array 5 and OP 24

Receptor type: Observation Point
No glare found

South - Bess PV array 5 and OP 25

Receptor type: Observation Point
No glare found

South - Bess PV array 5 and OP 26

Receptor type: Observation Point
No glare found

South - Bess PV array 5 and OP 27

Receptor type: Observation Point
No glare found

PV: Southeast Slope PV array no glare found

Receptor results ordered by category of glare

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
Birriwa Bus Route North	0	0.0	0	0.0
Birriwa Bus Route South - Cycle Trail	0	0.0	0	0.0
Castlereigh Hwy	0	0.0	0	0.0
Golden Hwy	0	0.0	0	0.0
Merotherie Rd	0	0.0	0	0.0
Railway	0	0.0	0	0.0
OP 1	0	0.0	0	0.0
OP 2	0	0.0	0	0.0
OP 3	0	0.0	0	0.0
OP 4	0	0.0	0	0.0
OP 5	0	0.0	0	0.0
OP 6	0	0.0	0	0.0
OP 7	0	0.0	0	0.0
OP 8	0	0.0	0	0.0
OP 9	0	0.0	0	0.0
OP 10	0	0.0	0	0.0
OP 11	0	0.0	0	0.0
OP 12	0	0.0	0	0.0
OP 13	0	0.0	0	0.0
OP 14	0	0.0	0	0.0
OP 15	0	0.0	0	0.0
OP 16	0	0.0	0	0.0
OP 17	0	0.0	0	0.0
OP 18	0	0.0	0	0.0
OP 19	0	0.0	0	0.0
OP 20	0	0.0	0	0.0
OP 21	0	0.0	0	0.0
OP 22	0	0.0	0	0.0
OP 23	0	0.0	0	0.0
OP 24	0	0.0	0	0.0
OP 25	0	0.0	0	0.0
OP 26	0	0.0	0	0.0
OP 27	0	0.0	0	0.0

Southeast Slope PV array and Birriwa Bus Route North

Receptor type: Route
No glare found

Southeast Slope PV array and Birriwa Bus Route South - Cycle Trail

Receptor type: Route
No glare found

Southeast Slope PV array and Castlereigh Hwy

Receptor type: Route
No glare found

Southeast Slope PV array and Golden Hwy

Receptor type: Route
No glare found

Southeast Slope PV array and Merotherie Rd

Receptor type: Route
No glare found

Southeast Slope PV array and Railway

Receptor type: Route
No glare found

Southeast Slope PV array and OP 1

Receptor type: Observation Point
No glare found

Southeast Slope PV array and OP 2

Receptor type: Observation Point
No glare found

Southeast Slope PV array and OP 3

Receptor type: Observation Point
No glare found

Southeast Slope PV array and OP 4

Receptor type: Observation Point
No glare found

Southeast Slope PV array and OP 5

Receptor type: Observation Point
No glare found

Southeast Slope PV array and OP 6

Receptor type: Observation Point
No glare found

Southeast Slope PV array and OP 7

Receptor type: Observation Point
No glare found

Southeast Slope PV array and OP 8

Receptor type: Observation Point
No glare found

Southeast Slope PV array and OP 9

Receptor type: Observation Point
No glare found

Southeast Slope PV array and OP 10

Receptor type: Observation Point
No glare found

Southeast Slope PV array and OP 11

Receptor type: Observation Point
No glare found

Southeast Slope PV array and OP 12

Receptor type: Observation Point
No glare found

Southeast Slope PV array and OP 13

Receptor type: Observation Point
No glare found

Southeast Slope PV array and OP 14

Receptor type: Observation Point
No glare found

Southeast Slope PV array and OP 15

Receptor type: Observation Point
No glare found

Southeast Slope PV array and OP 16

Receptor type: Observation Point
No glare found

Southeast Slope PV array and OP 17

Receptor type: Observation Point
No glare found

Southeast Slope PV array and OP 18

Receptor type: Observation Point
No glare found

Southeast Slope PV array and OP 19

Receptor type: Observation Point
No glare found

Southeast Slope PV array and OP 20

Receptor type: Observation Point
No glare found

Southeast Slope PV array and OP 21

Receptor type: Observation Point
No glare found

Southeast Slope PV array and OP 22

Receptor type: Observation Point
No glare found

Southeast Slope PV array and OP 23

Receptor type: Observation Point
No glare found

Southeast Slope PV array and OP 24

Receptor type: Observation Point
No glare found

Southeast Slope PV array and OP 25

Receptor type: Observation Point
No glare found

Southeast Slope PV array and OP 26

Receptor type: Observation Point
No glare found

Southeast Slope PV array and OP 27

Receptor type: Observation Point
No glare found

PV: West - northern PV array 3 no glare found

Receptor results ordered by category of glare

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
Birriwa Bus Route North	0	0.0	0	0.0
Birriwa Bus Route South - Cycle Trail	0	0.0	0	0.0
Castlereigh Hwy	0	0.0	0	0.0
Golden Hwy	0	0.0	0	0.0
Merotherie Rd	0	0.0	0	0.0
Railway	0	0.0	0	0.0
OP 1	0	0.0	0	0.0
OP 2	0	0.0	0	0.0
OP 3	0	0.0	0	0.0
OP 4	0	0.0	0	0.0
OP 5	0	0.0	0	0.0
OP 6	0	0.0	0	0.0
OP 7	0	0.0	0	0.0
OP 8	0	0.0	0	0.0
OP 9	0	0.0	0	0.0
OP 10	0	0.0	0	0.0
OP 11	0	0.0	0	0.0
OP 12	0	0.0	0	0.0
OP 13	0	0.0	0	0.0
OP 14	0	0.0	0	0.0
OP 15	0	0.0	0	0.0
OP 16	0	0.0	0	0.0
OP 17	0	0.0	0	0.0
OP 18	0	0.0	0	0.0
OP 19	0	0.0	0	0.0
OP 20	0	0.0	0	0.0
OP 21	0	0.0	0	0.0
OP 22	0	0.0	0	0.0
OP 23	0	0.0	0	0.0
OP 24	0	0.0	0	0.0
OP 25	0	0.0	0	0.0
OP 26	0	0.0	0	0.0
OP 27	0	0.0	0	0.0

West - northern PV array 3 and Birriwa Bus Route North

Receptor type: Route
No glare found

West - northern PV array 3 and Birriwa Bus Route South - Cycle Trail

Receptor type: Route
No glare found

West - northern PV array 3 and Castlereigh Hwy

Receptor type: Route
No glare found

West - northern PV array 3 and Golden Hwy

Receptor type: Route
No glare found

West - northern PV array 3 and Merotherie Rd

Receptor type: Route
No glare found

West - northern PV array 3 and Railway

Receptor type: Route
No glare found

West - northern PV array 3 and OP 1

Receptor type: Observation Point
No glare found

West - northern PV array 3 and OP 2

Receptor type: Observation Point
No glare found

West - northern PV array 3 and OP 3

Receptor type: Observation Point
No glare found

West - northern PV array 3 and OP 4

Receptor type: Observation Point
No glare found

West - northern PV array 3 and OP 5

Receptor type: Observation Point
No glare found

West - northern PV array 3 and OP 6

Receptor type: Observation Point
No glare found

West - northern PV array 3 and OP 7

Receptor type: Observation Point
No glare found

West - northern PV array 3 and OP 8

Receptor type: Observation Point
No glare found

West - northern PV array 3 and OP 9

Receptor type: Observation Point
No glare found

West - northern PV array 3 and OP 10

Receptor type: Observation Point
No glare found

West - northern PV array 3 and OP 11

Receptor type: Observation Point
No glare found

West - northern PV array 3 and OP 12

Receptor type: Observation Point
No glare found

West - northern PV array 3 and OP 13

Receptor type: Observation Point
No glare found

West - northern PV array 3 and OP 14

Receptor type: Observation Point
No glare found

West - northern PV array 3 and OP 15

Receptor type: Observation Point
No glare found

West - northern PV array 3 and OP 16

Receptor type: Observation Point
No glare found

West - northern PV array 3 and OP 17

Receptor type: Observation Point
No glare found

West - northern PV array 3 and OP 18

Receptor type: Observation Point
No glare found

West - northern PV array 3 and OP 19

Receptor type: Observation Point
No glare found

West - northern PV array 3 and OP 20

Receptor type: Observation Point
No glare found

West - northern PV array 3 and OP 21

Receptor type: Observation Point
No glare found

West - northern PV array 3 and OP 22

Receptor type: Observation Point
No glare found

West - northern PV array 3 and OP 23

Receptor type: Observation Point
No glare found

West - northern PV array 3 and OP 24

Receptor type: Observation Point
No glare found

West - northern PV array 3 and OP 25

Receptor type: Observation Point
No glare found

West - northern PV array 3 and OP 26

Receptor type: Observation Point
No glare found

West - northern PV array 3 and OP 27

Receptor type: Observation Point
No glare found

PV: West - PV array 1 no glare found

Receptor results ordered by category of glare

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
Birriwa Bus Route North	0	0.0	0	0.0
Birriwa Bus Route South - Cycle Trail	0	0.0	0	0.0
Castlereigh Hwy	0	0.0	0	0.0
Golden Hwy	0	0.0	0	0.0
Merotherie Rd	0	0.0	0	0.0
Railway	0	0.0	0	0.0
OP 1	0	0.0	0	0.0
OP 2	0	0.0	0	0.0
OP 3	0	0.0	0	0.0
OP 4	0	0.0	0	0.0
OP 5	0	0.0	0	0.0
OP 6	0	0.0	0	0.0
OP 7	0	0.0	0	0.0
OP 8	0	0.0	0	0.0
OP 9	0	0.0	0	0.0
OP 10	0	0.0	0	0.0
OP 11	0	0.0	0	0.0
OP 12	0	0.0	0	0.0
OP 13	0	0.0	0	0.0
OP 14	0	0.0	0	0.0
OP 15	0	0.0	0	0.0
OP 16	0	0.0	0	0.0
OP 17	0	0.0	0	0.0
OP 18	0	0.0	0	0.0
OP 19	0	0.0	0	0.0
OP 20	0	0.0	0	0.0
OP 21	0	0.0	0	0.0
OP 22	0	0.0	0	0.0
OP 23	0	0.0	0	0.0
OP 24	0	0.0	0	0.0
OP 25	0	0.0	0	0.0
OP 26	0	0.0	0	0.0
OP 27	0	0.0	0	0.0

West - PV array 1 and Birriwa Bus Route North

Receptor type: Route
No glare found

West - PV array 1 and Birriwa Bus Route South - Cycle Trail

Receptor type: Route
No glare found

West - PV array 1 and Castlereigh Hwy

Receptor type: Route
No glare found

West - PV array 1 and Golden Hwy

Receptor type: Route
No glare found

West - PV array 1 and Merotherie Rd

Receptor type: Route
No glare found

West - PV array 1 and Railway

Receptor type: Route
No glare found

West - PV array 1 and OP 1

Receptor type: Observation Point
No glare found

West - PV array 1 and OP 2

Receptor type: Observation Point
No glare found

West - PV array 1 and OP 3

Receptor type: Observation Point
No glare found

West - PV array 1 and OP 4

Receptor type: Observation Point
No glare found

West - PV array 1 and OP 5

Receptor type: Observation Point
No glare found

West - PV array 1 and OP 6

Receptor type: Observation Point
No glare found

West - PV array 1 and OP 7

Receptor type: Observation Point
No glare found

West - PV array 1 and OP 8

Receptor type: Observation Point
No glare found

West - PV array 1 and OP 9

Receptor type: Observation Point
No glare found

West - PV array 1 and OP 10

Receptor type: Observation Point
No glare found

West - PV array 1 and OP 11

Receptor type: Observation Point
No glare found

West - PV array 1 and OP 12

Receptor type: Observation Point
No glare found

West - PV array 1 and OP 13

Receptor type: Observation Point
No glare found

West - PV array 1 and OP 14

Receptor type: Observation Point
No glare found

West - PV array 1 and OP 15

Receptor type: Observation Point
No glare found

West - PV array 1 and OP 16

Receptor type: Observation Point
No glare found

West - PV array 1 and OP 17

Receptor type: Observation Point
No glare found

West - PV array 1 and OP 18

Receptor type: Observation Point
No glare found

West - PV array 1 and OP 19

Receptor type: Observation Point
No glare found

West - PV array 1 and OP 20

Receptor type: Observation Point
No glare found

West - PV array 1 and OP 21

Receptor type: Observation Point
No glare found

West - PV array 1 and OP 22

Receptor type: Observation Point
No glare found

West - PV array 1 and OP 23

Receptor type: Observation Point
No glare found

West - PV array 1 and OP 24

Receptor type: Observation Point
No glare found

West - PV array 1 and OP 25

Receptor type: Observation Point
No glare found

West - PV array 1 and OP 26

Receptor type: Observation Point
No glare found

West - PV array 1 and OP 27

Receptor type: Observation Point
No glare found

VS: East BESS

VS Face: 1-2 potential temporary after-image

Receptor results ordered by category of glare

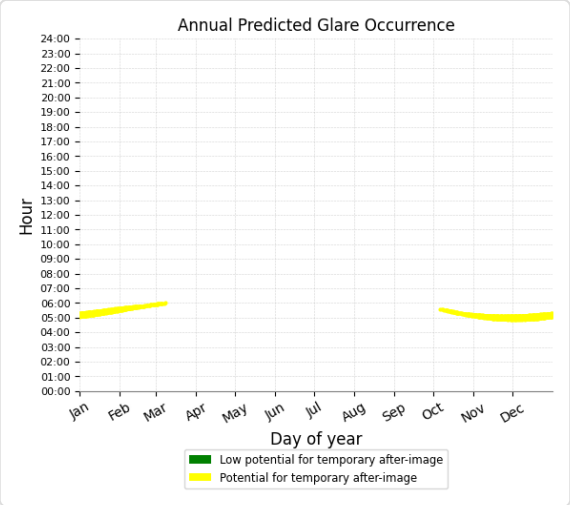
Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
Birriwa Bus Route South - Cycle Trail	0	0.0	1,381	23.0
Merotherie Rd	173	2.9	0	0.0
Birriwa Bus Route North	0	0.0	0	0.0
Castlereigh Hwy	0	0.0	0	0.0
Golden Hwy	0	0.0	0	0.0
Railway	0	0.0	0	0.0
OP 9	0	0.0	93	1.6
OP 1	0	0.0	0	0.0
OP 2	0	0.0	0	0.0
OP 3	0	0.0	0	0.0
OP 4	0	0.0	0	0.0
OP 5	0	0.0	0	0.0
OP 6	0	0.0	0	0.0
OP 7	0	0.0	0	0.0
OP 8	0	0.0	0	0.0
OP 10	0	0.0	0	0.0
OP 11	0	0.0	0	0.0
OP 12	0	0.0	0	0.0
OP 13	0	0.0	0	0.0
OP 14	0	0.0	0	0.0
OP 15	0	0.0	0	0.0
OP 16	0	0.0	0	0.0
OP 17	0	0.0	0	0.0
OP 18	0	0.0	0	0.0
OP 19	0	0.0	0	0.0
OP 20	0	0.0	0	0.0
OP 21	0	0.0	0	0.0
OP 22	0	0.0	0	0.0
OP 23	0	0.0	0	0.0
OP 24	0	0.0	0	0.0
OP 25	0	0.0	0	0.0
OP 26	0	0.0	0	0.0
OP 27	0	0.0	0	0.0

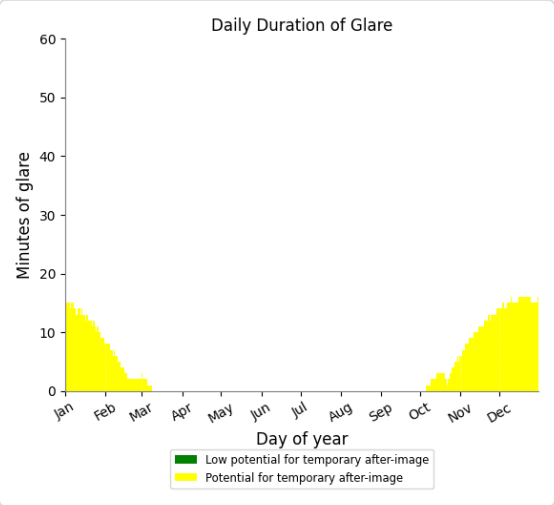
Birriwa Bus Route South - Cycle Trail

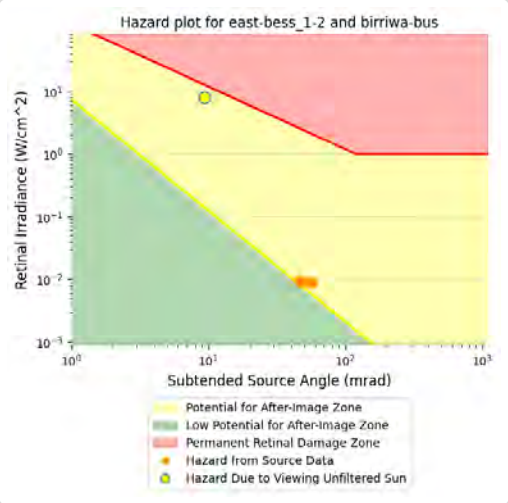
Receptor type: Route

1,381 minutes of yellow glare

0 minutes of green glare

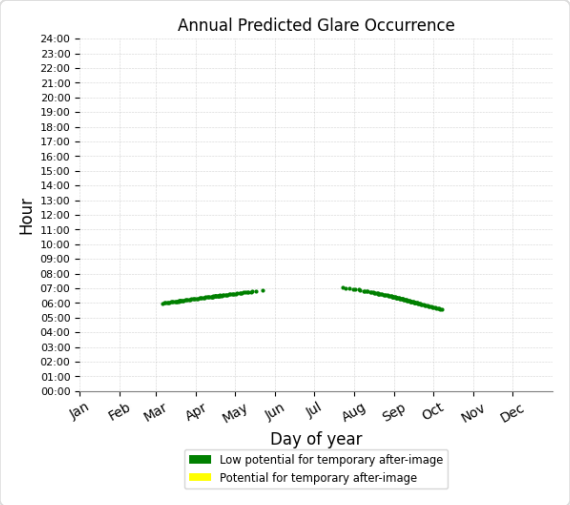


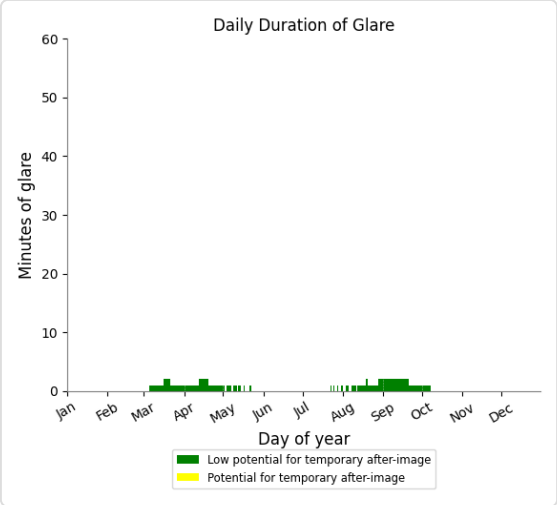




Merotherie Rd

Receptor type: Route
0 minutes of yellow glare
173 minutes of green glare





Birriwa Bus Route North

Receptor type: Route
No glare found

Castlereigh Hwy

Receptor type: Route
No glare found

Golden Hwy

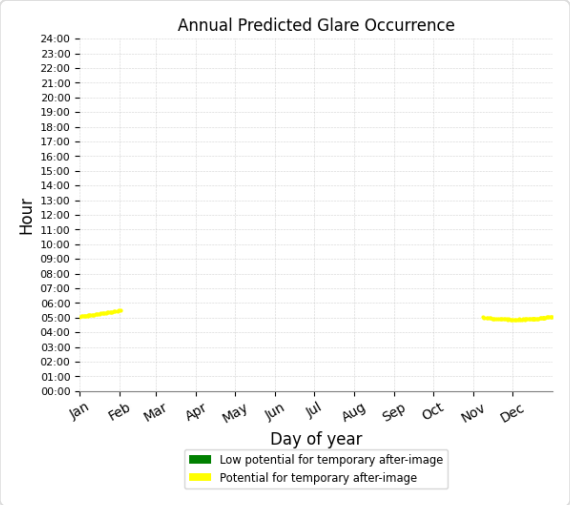
Receptor type: Route
No glare found

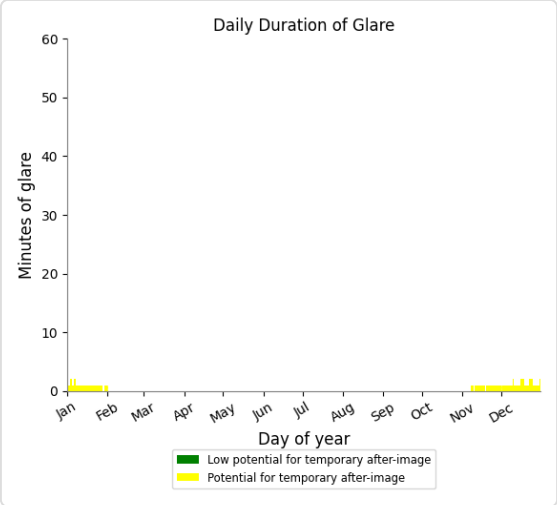
Railway

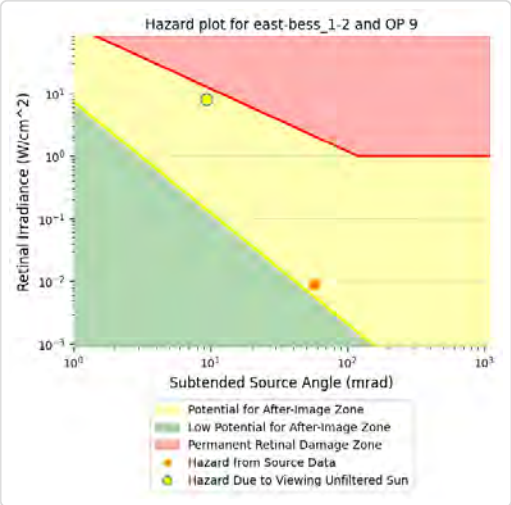
Receptor type: Route
No glare found

OP 9

Receptor type: Observation Point
93 minutes of yellow glare
0 minutes of green glare







OP 1

Receptor type: Observation Point
No glare found

OP 2

Receptor type: Observation Point
No glare found

OP 3

Receptor type: Observation Point
No glare found

OP 4

Receptor type: Observation Point
No glare found

OP 5

Receptor type: Observation Point
No glare found

OP 6

Receptor type: Observation Point
No glare found

OP 7

Receptor type: Observation Point
No glare found

OP 8

Receptor type: Observation Point
No glare found

OP 10

Receptor type: Observation Point
No glare found

OP 11

Receptor type: Observation Point
No glare found

OP 12

Receptor type: Observation Point
No glare found

OP 13

Receptor type: Observation Point
No glare found

OP 14

Receptor type: Observation Point
No glare found

OP 15

Receptor type: Observation Point
No glare found

OP 16

Receptor type: Observation Point
No glare found

OP 17

Receptor type: Observation Point
No glare found

OP 18

Receptor type: Observation Point
No glare found

OP 19

Receptor type: Observation Point
No glare found

OP 20

Receptor type: Observation Point
No glare found

OP 21

Receptor type: Observation Point
No glare found

OP 22

Receptor type: Observation Point
No glare found

OP 23

Receptor type: Observation Point
No glare found

OP 24

Receptor type: Observation Point
No glare found

OP 25

Receptor type: Observation Point
No glare found

OP 26

Receptor type: Observation Point
No glare found

OP 27

Receptor type: Observation Point
No glare found

VS Face: 2-3 low potential for temporary after-image

Receptor results ordered by category of glare

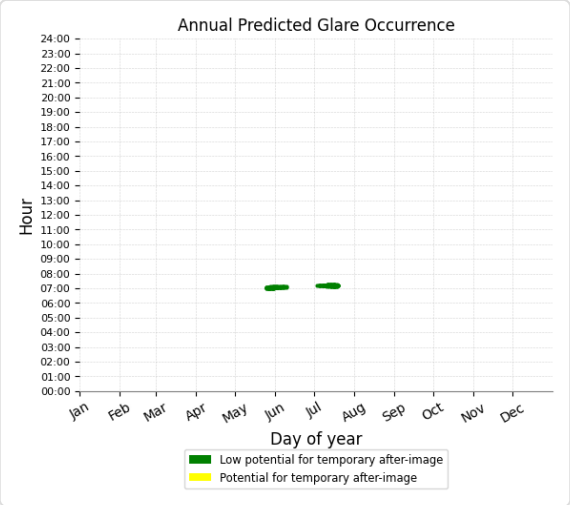
Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
Birriwa Bus Route North	173	2.9	0	0.0
Birriwa Bus Route South - Cycle Trail	2,111	35.2	0	0.0
Railway	196	3.3	0	0.0
Castlereigh Hwy	0	0.0	0	0.0
Golden Hwy	0	0.0	0	0.0
Merotherie Rd	0	0.0	0	0.0
OP 1	17	0.3	0	0.0
OP 2	43	0.7	0	0.0
OP 3	11	0.2	0	0.0
OP 4	1	0.0	0	0.0
OP 12	1	0.0	0	0.0
OP 13	2	0.0	0	0.0
OP 14	2	0.0	0	0.0
OP 15	2	0.0	0	0.0
OP 16	2	0.0	0	0.0
OP 17	2	0.0	0	0.0
OP 18	3	0.1	0	0.0
OP 19	2	0.0	0	0.0
OP 20	92	1.5	0	0.0
OP 22	15	0.2	0	0.0
OP 23	23	0.4	0	0.0
OP 5	0	0.0	0	0.0
OP 6	0	0.0	0	0.0
OP 7	0	0.0	0	0.0
OP 8	0	0.0	0	0.0
OP 9	0	0.0	0	0.0
OP 10	0	0.0	0	0.0
OP 11	0	0.0	0	0.0
OP 21	0	0.0	0	0.0
OP 24	0	0.0	0	0.0
OP 25	0	0.0	0	0.0
OP 26	0	0.0	0	0.0
OP 27	0	0.0	0	0.0

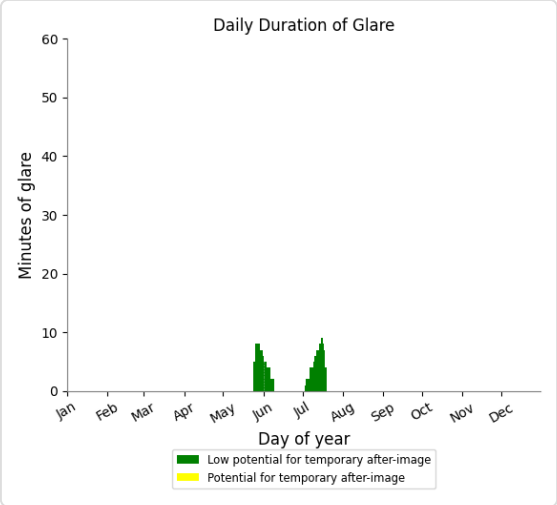
Birriwa Bus Route North

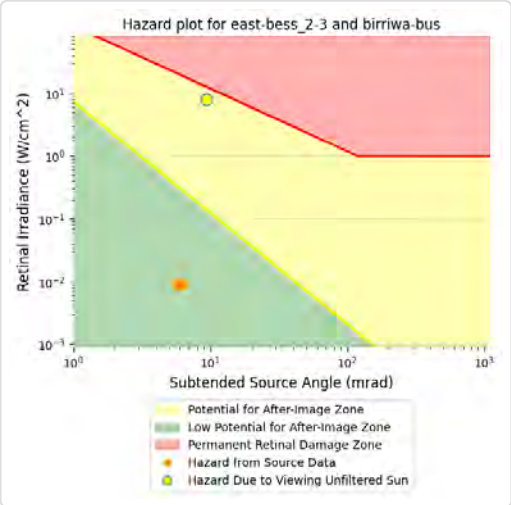
Receptor type: Route

0 minutes of yellow glare

173 minutes of green glare





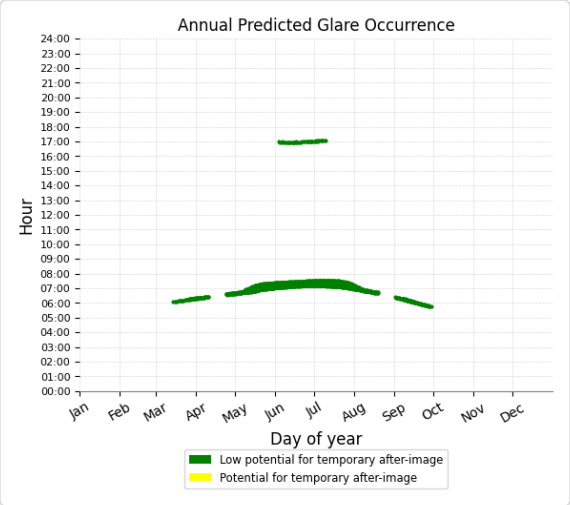


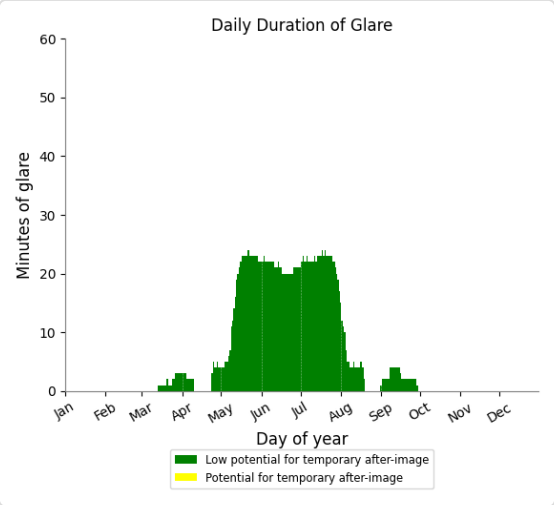
Birriwa Bus Route South - Cycle Trail

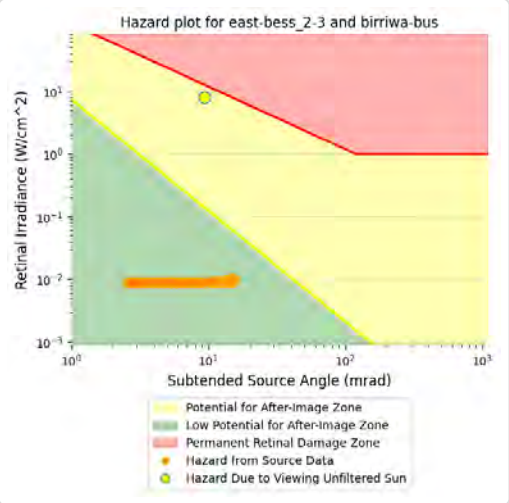
Receptor type: Route

0 minutes of yellow glare

2,111 minutes of green glare

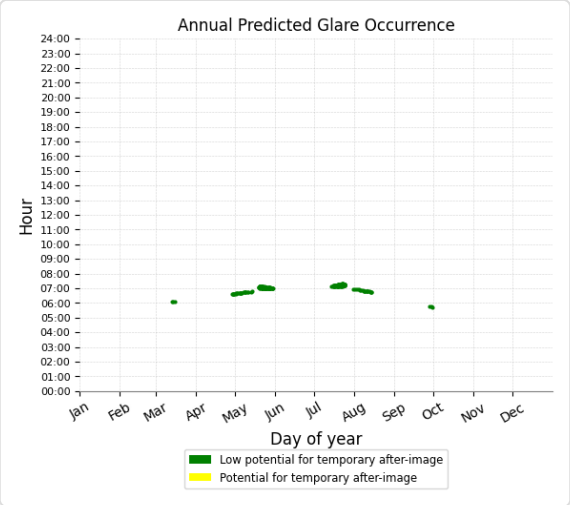


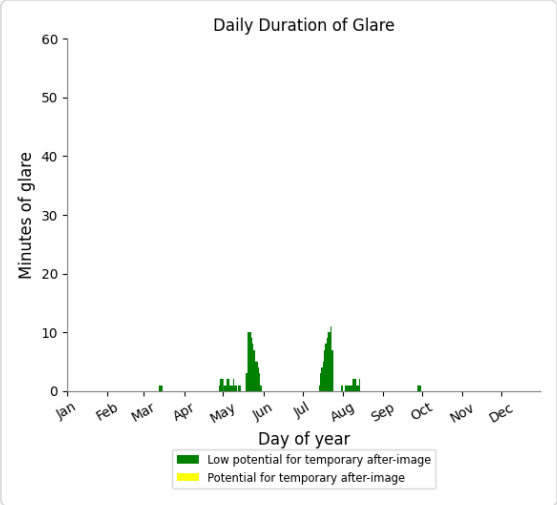


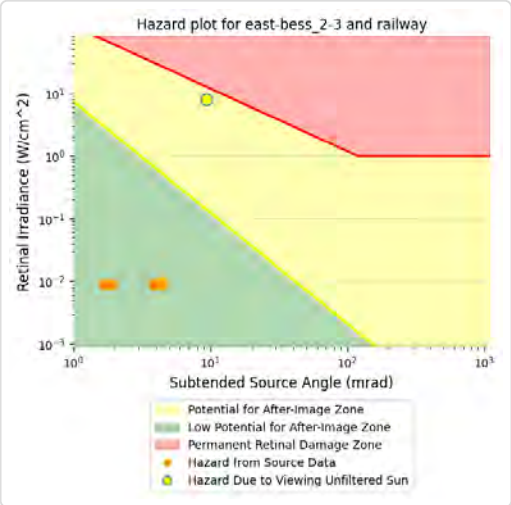


Railway

Receptor type: Route
0 minutes of yellow glare
196 minutes of green glare







Castlereigh Hwy

Receptor type: Route
No glare found

Golden Hwy

Receptor type: Route
No glare found

Merotherie Rd

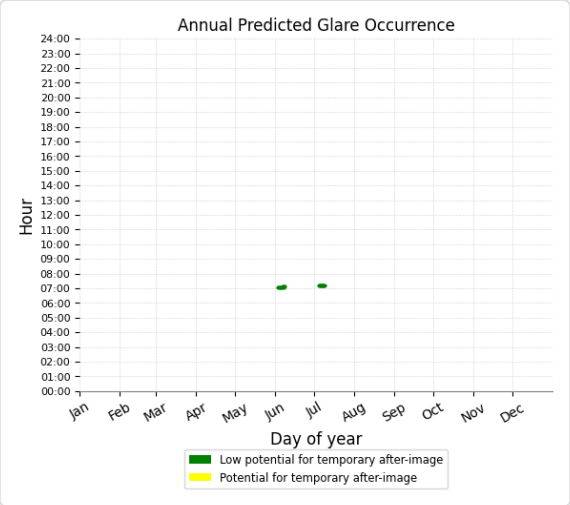
Receptor type: Route
No glare found

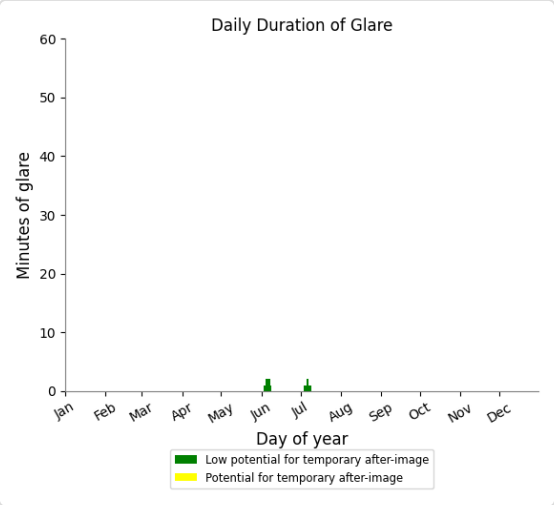
OP 1

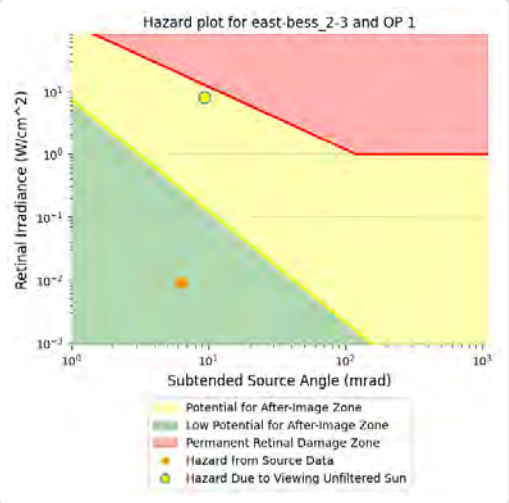
Receptor type: Observation Point

0 minutes of yellow glare

17 minutes of green glare





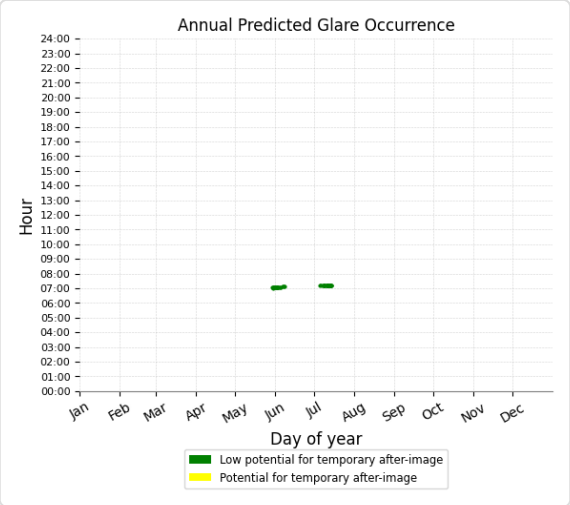


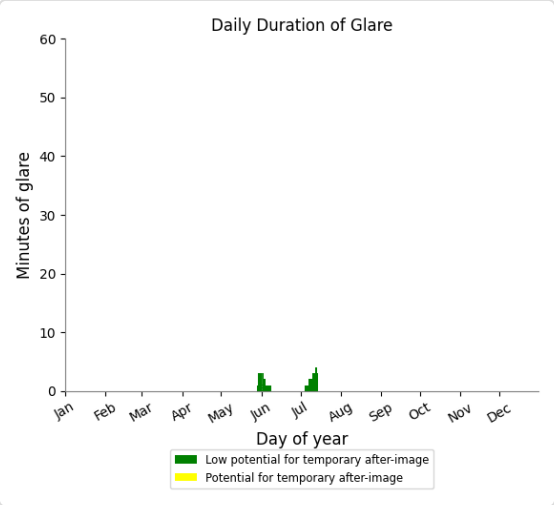
OP 2

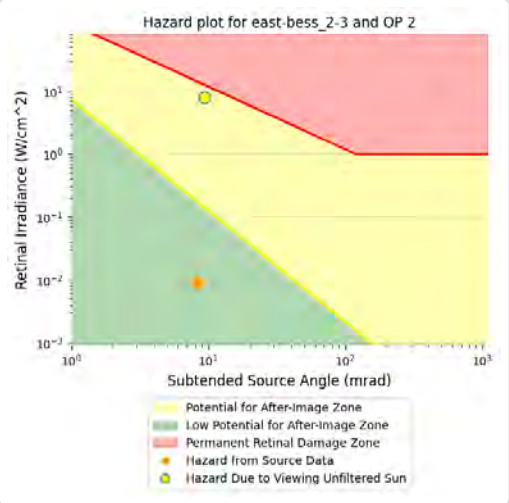
Receptor type: Observation Point

0 minutes of yellow glare

43 minutes of green glare





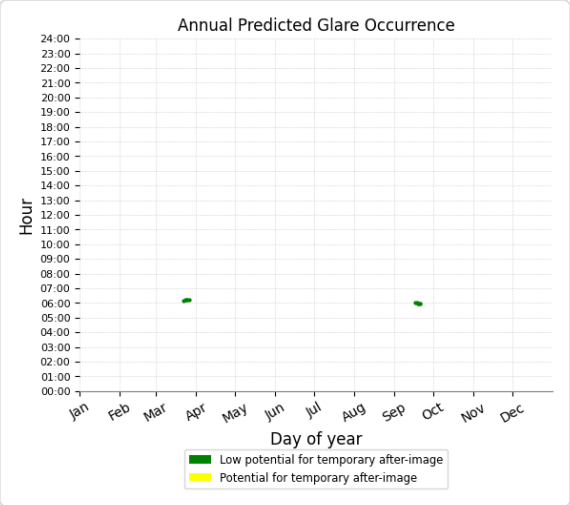


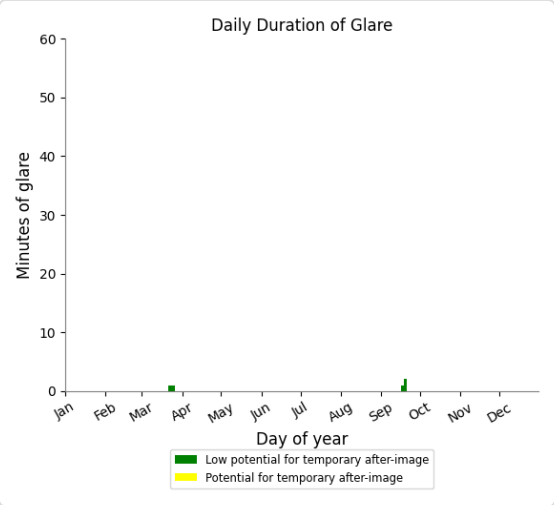
OP 3

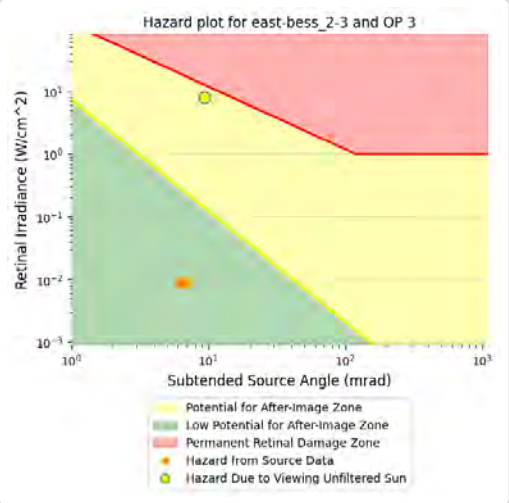
Receptor type: Observation Point

0 minutes of yellow glare

11 minutes of green glare





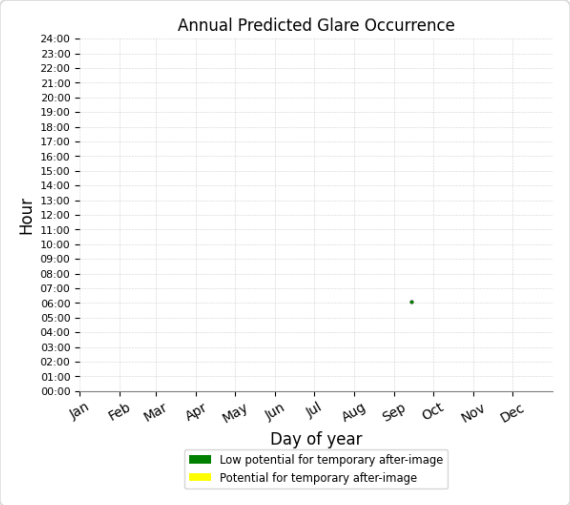


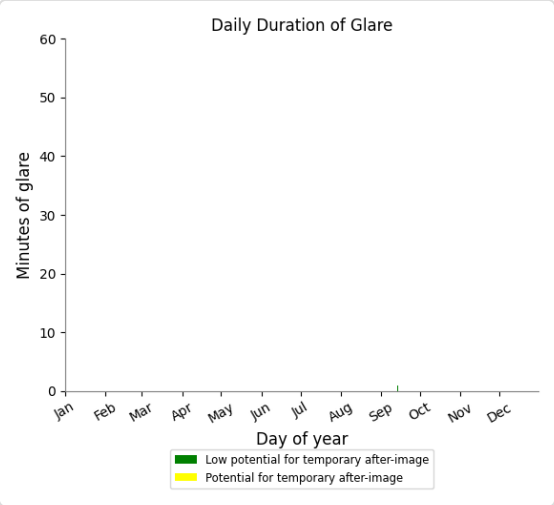
OP 4

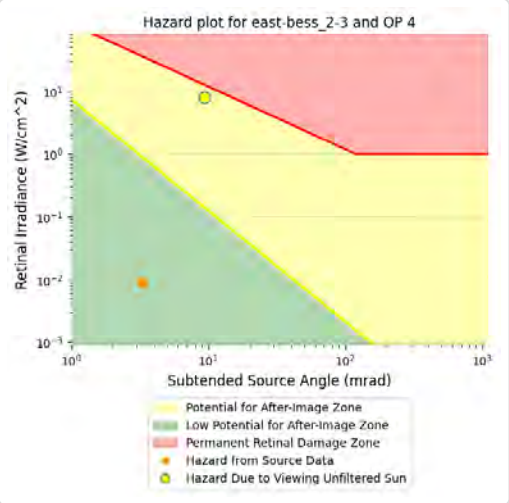
Receptor type: Observation Point

0 minutes of yellow glare

1 minutes of green glare





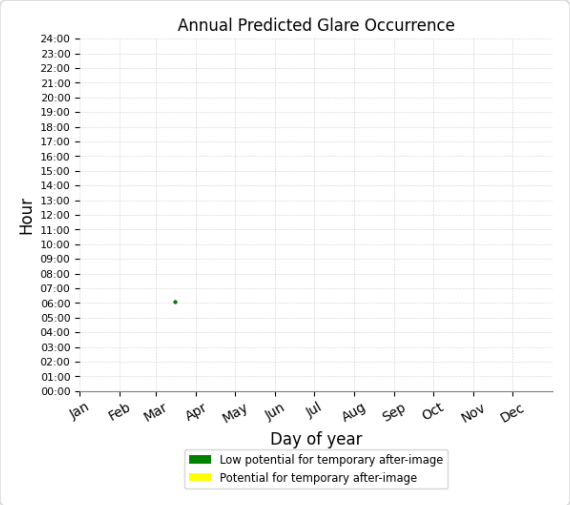


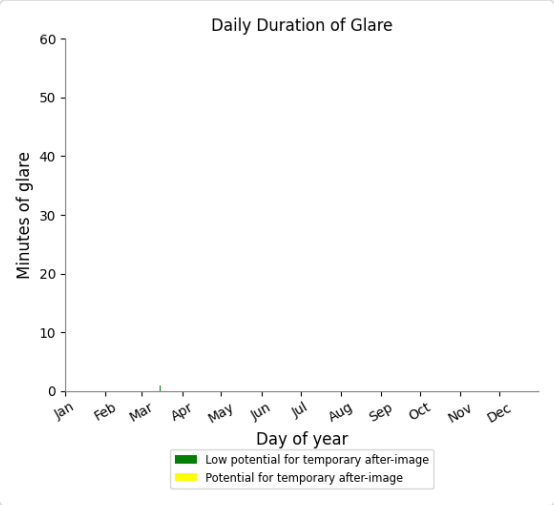
OP 12

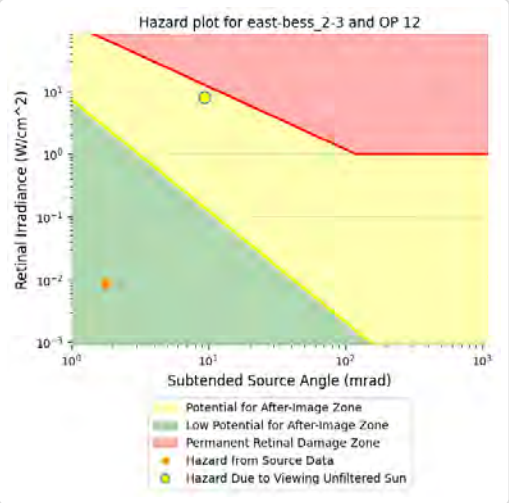
Receptor type: Observation Point

0 minutes of yellow glare

1 minutes of green glare





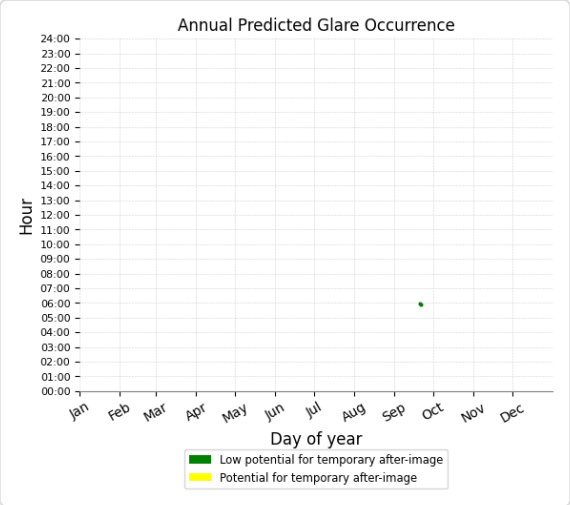


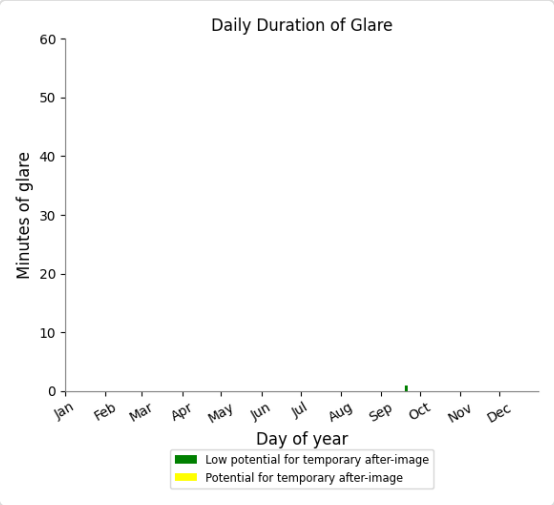
OP 13

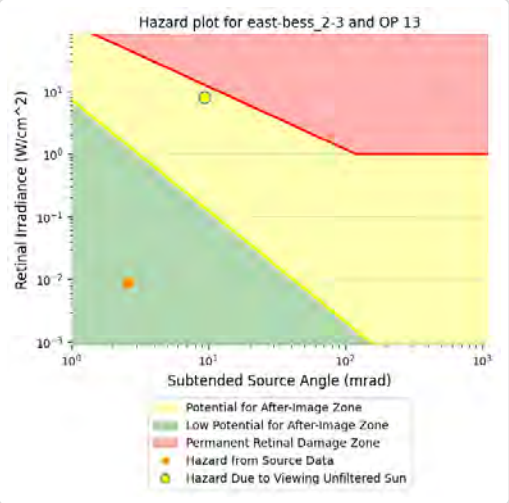
Receptor type: Observation Point

0 minutes of yellow glare

2 minutes of green glare





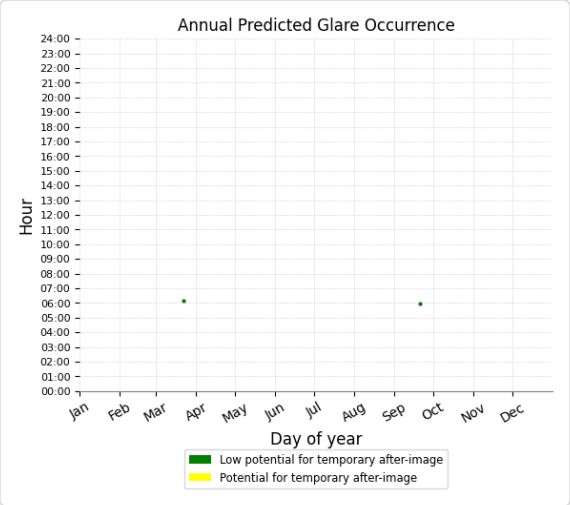


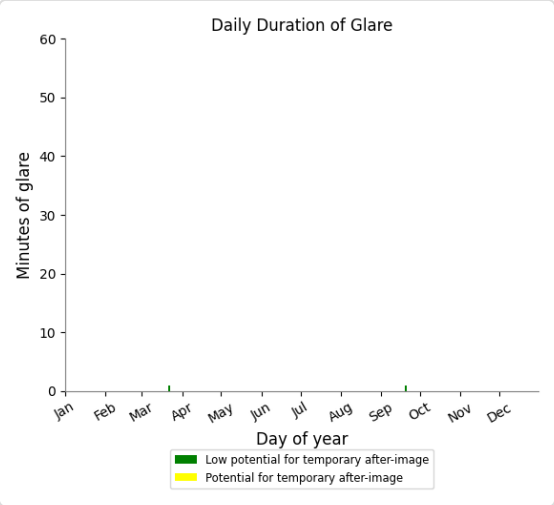
OP 14

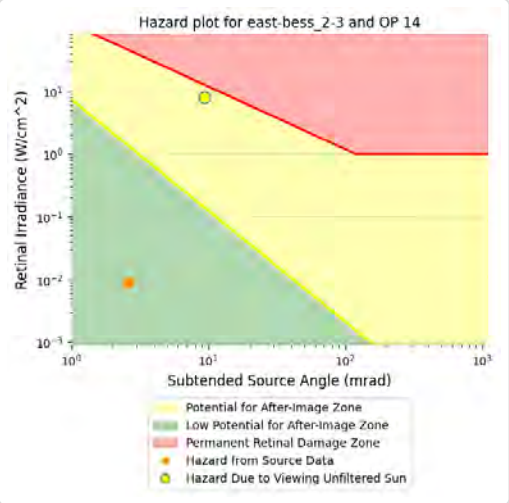
Receptor type: Observation Point

0 minutes of yellow glare

2 minutes of green glare





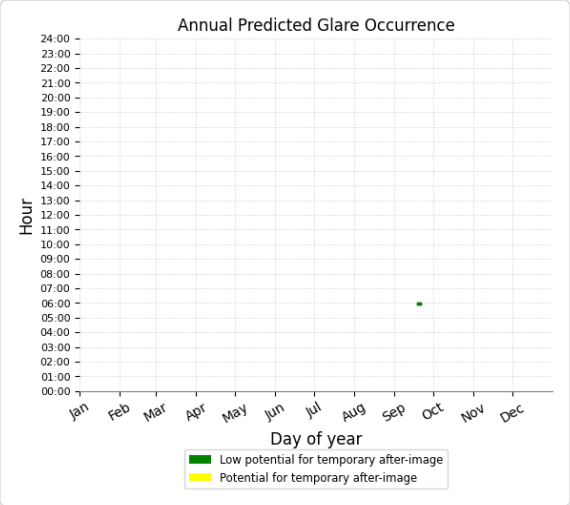


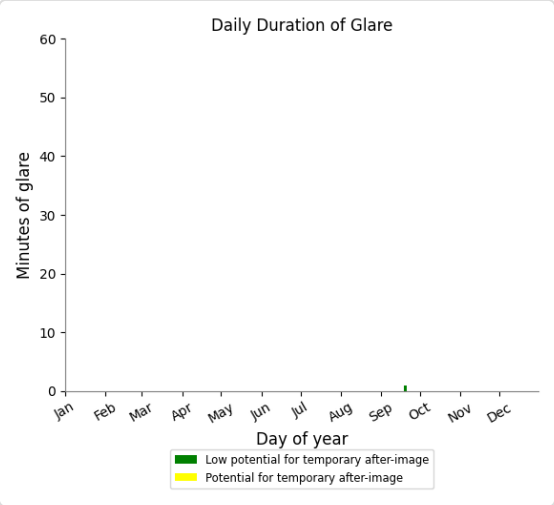
OP 15

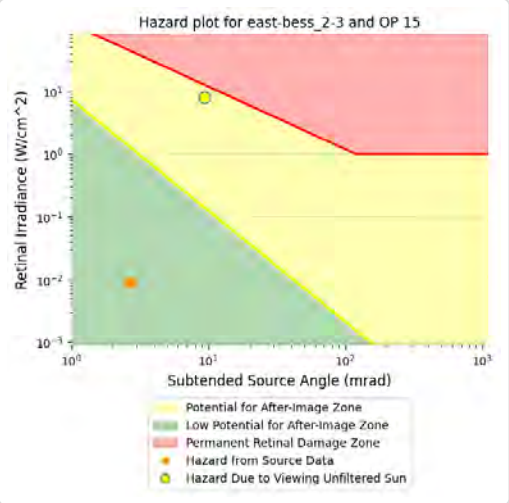
Receptor type: Observation Point

0 minutes of yellow glare

2 minutes of green glare





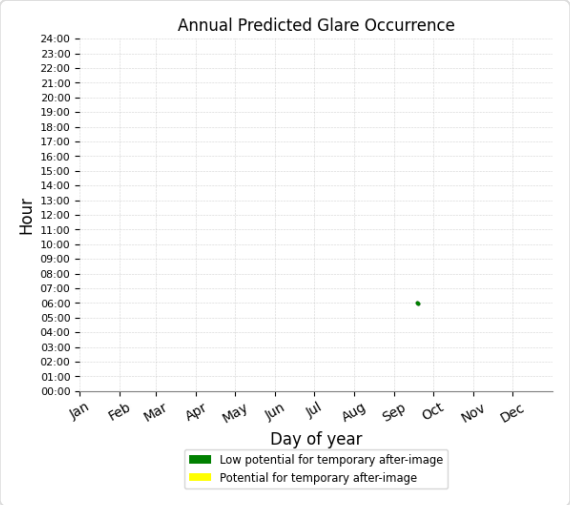


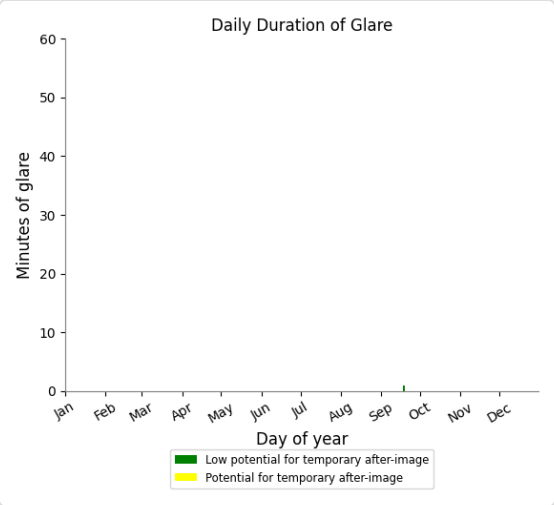
OP 16

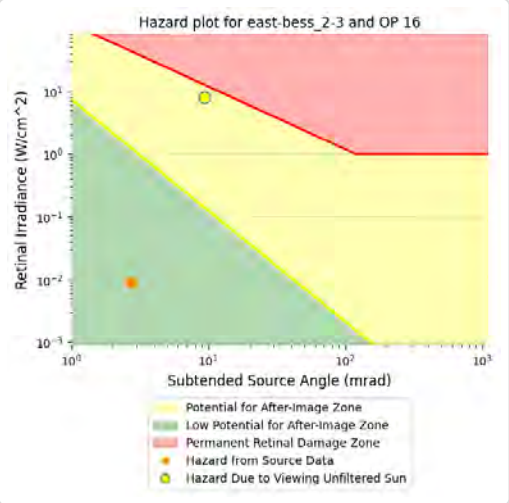
Receptor type: Observation Point

0 minutes of yellow glare

2 minutes of green glare





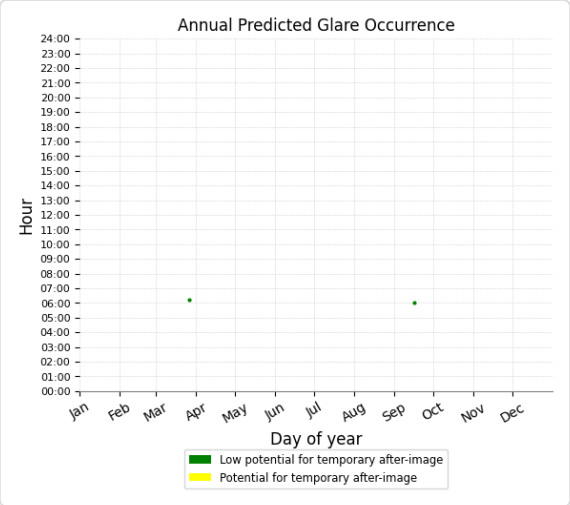


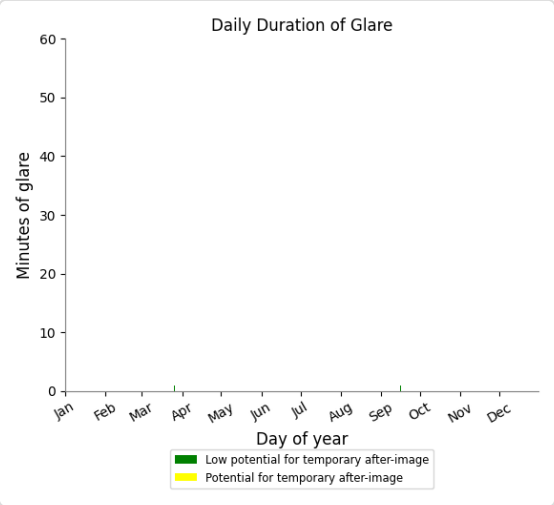
OP 17

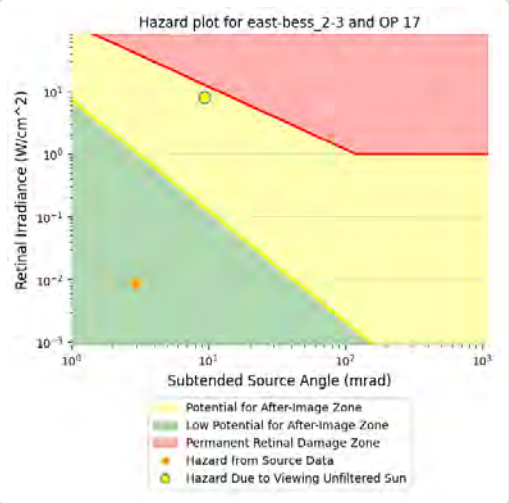
Receptor type: Observation Point

0 minutes of yellow glare

2 minutes of green glare





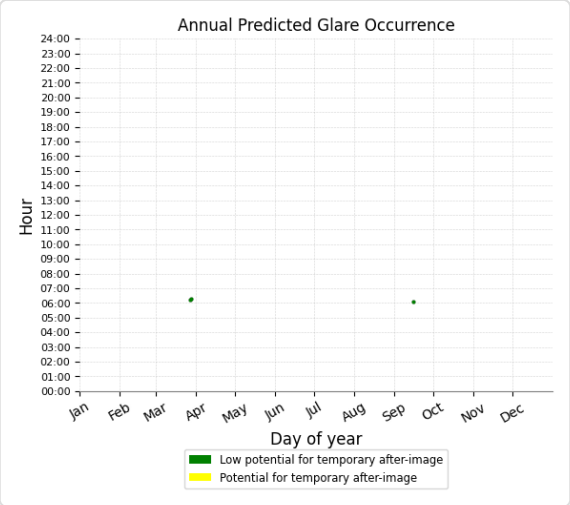


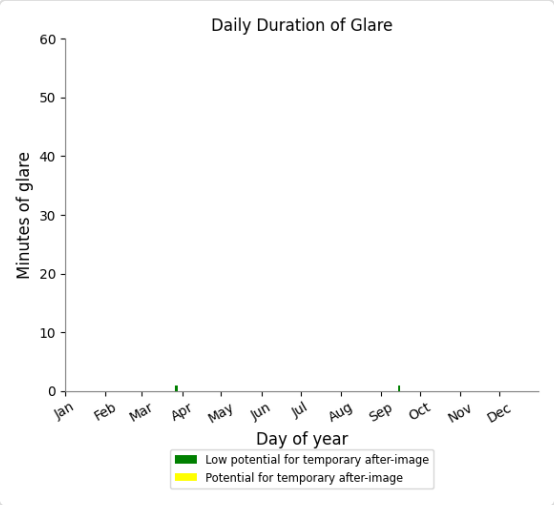
OP 18

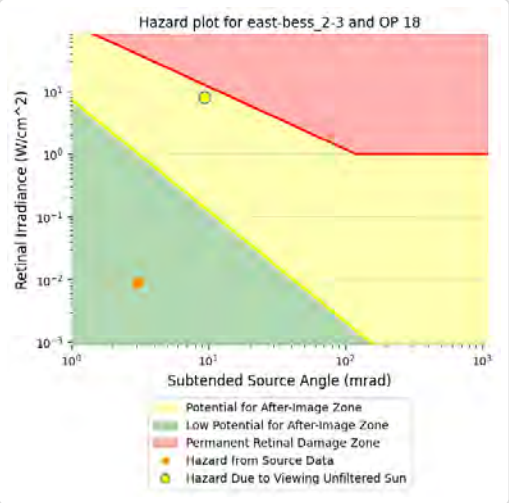
Receptor type: Observation Point

0 minutes of yellow glare

3 minutes of green glare





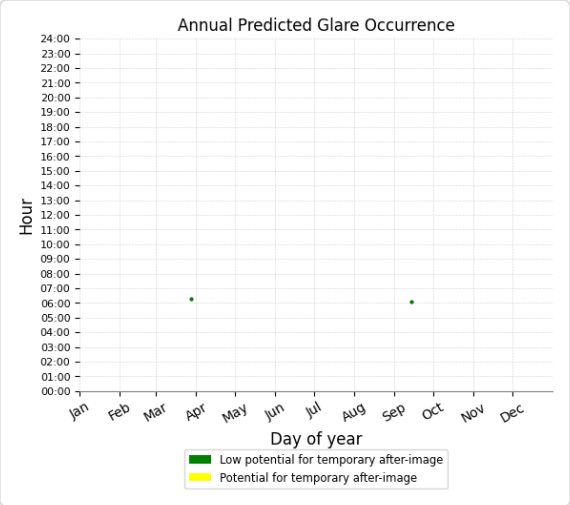


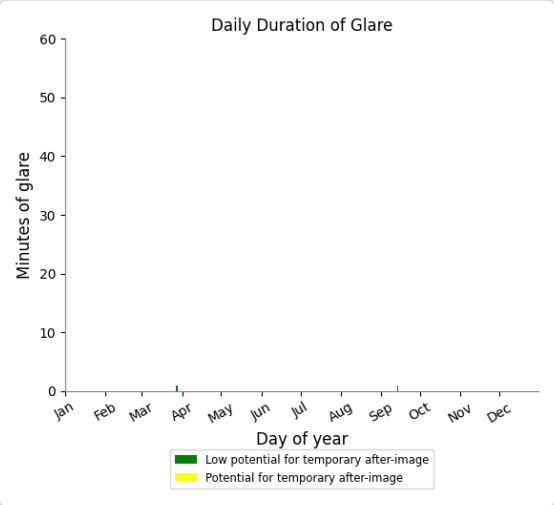
OP 19

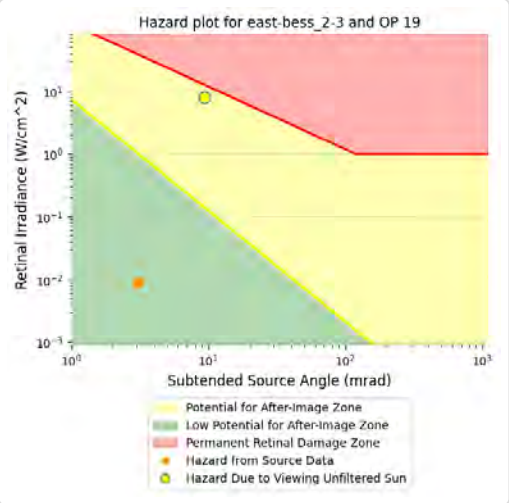
Receptor type: Observation Point

0 minutes of yellow glare

2 minutes of green glare

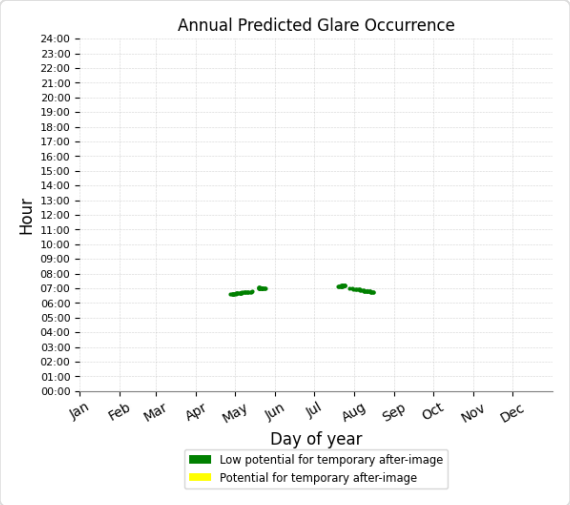


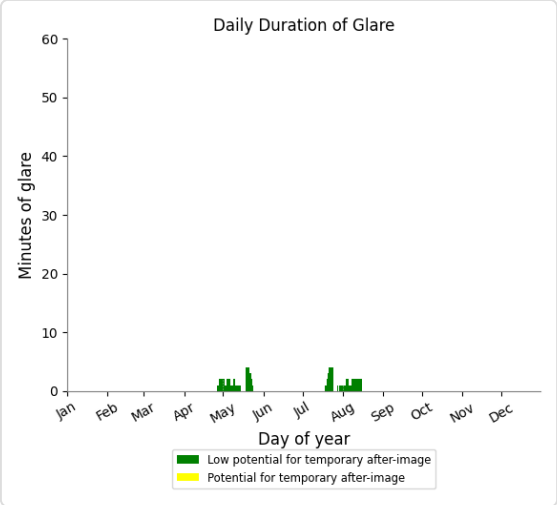


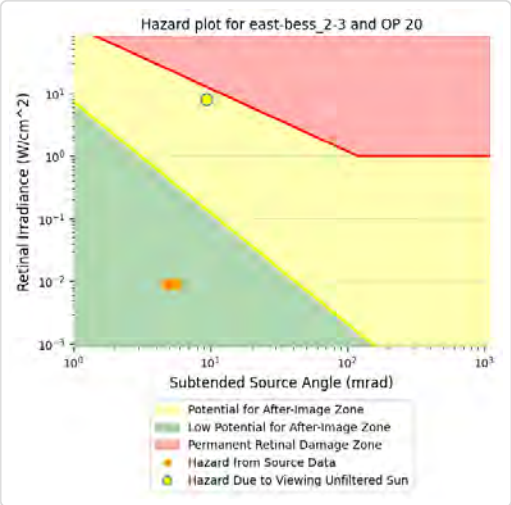


OP 20

Receptor type: Observation Point
0 minutes of yellow glare
92 minutes of green glare

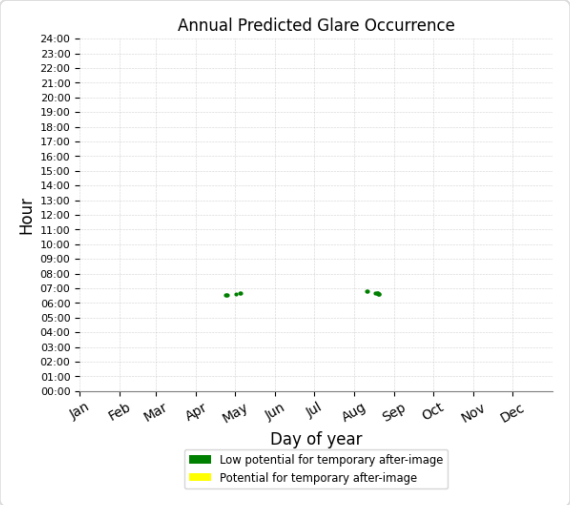


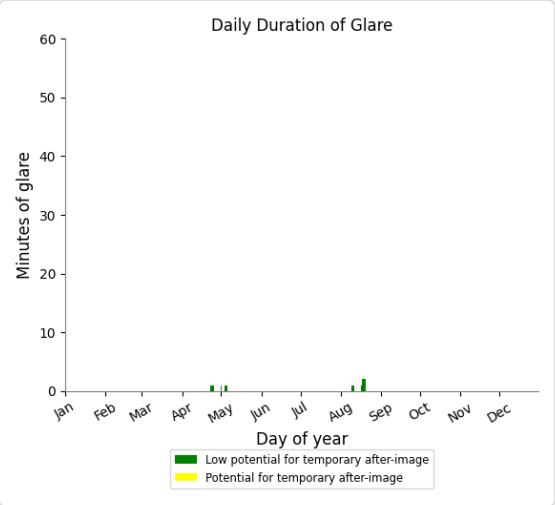


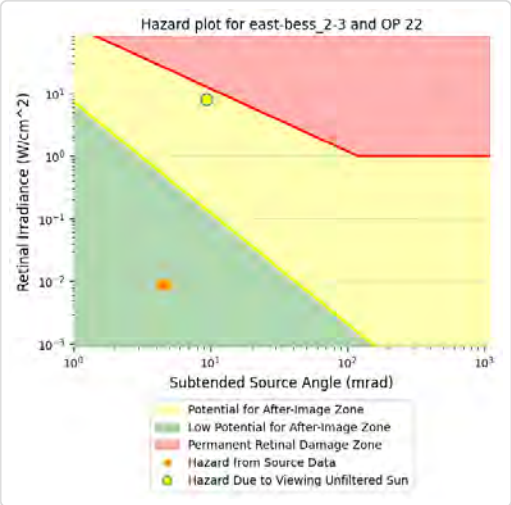


OP 22

Receptor type: Observation Point
0 minutes of yellow glare
15 minutes of green glare

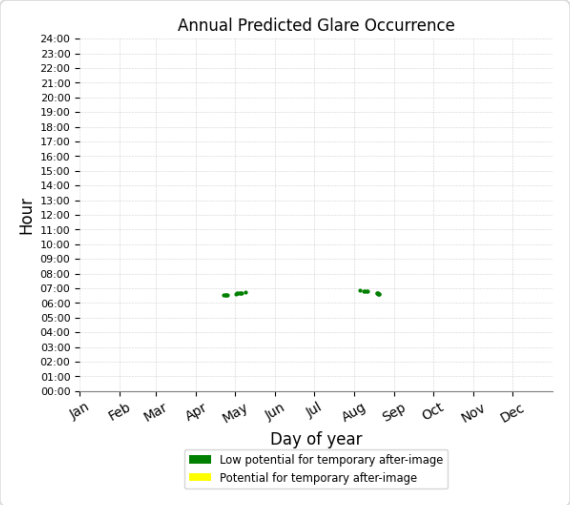


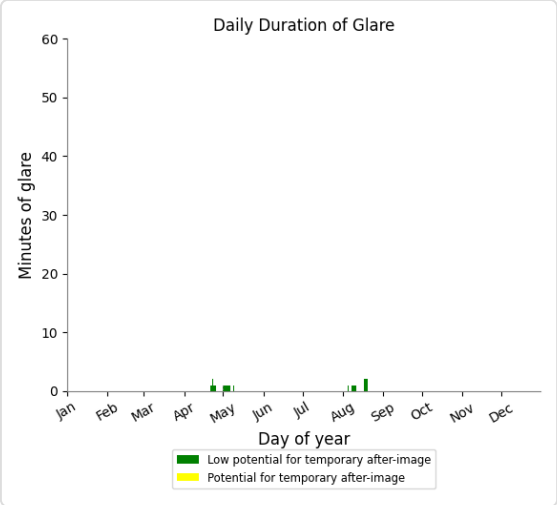


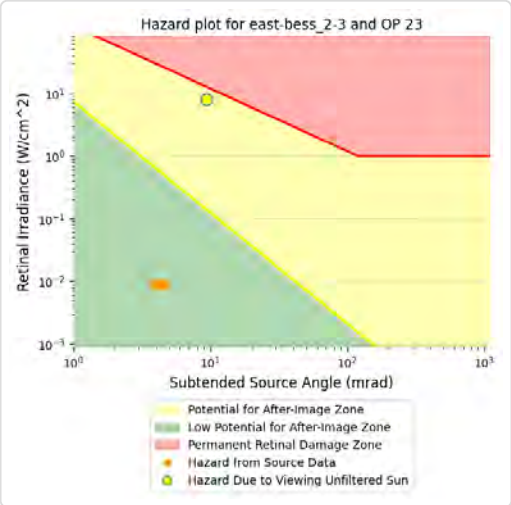


OP 23

Receptor type: Observation Point
0 minutes of yellow glare
23 minutes of green glare







OP 5

Receptor type: Observation Point
No glare found

OP 6

Receptor type: Observation Point
No glare found

OP 7

Receptor type: Observation Point
No glare found

OP 8

Receptor type: Observation Point
No glare found

OP 9

Receptor type: Observation Point
No glare found

OP 10

Receptor type: Observation Point
No glare found

OP 11

Receptor type: Observation Point
No glare found

OP 21

Receptor type: Observation Point
No glare found

OP 24

Receptor type: Observation Point
No glare found

OP 25

Receptor type: Observation Point
No glare found

OP 26

Receptor type: Observation Point
No glare found

OP 27

Receptor type: Observation Point
No glare found

VS Face: 3-4 potential temporary after-image

Receptor results ordered by category of glare

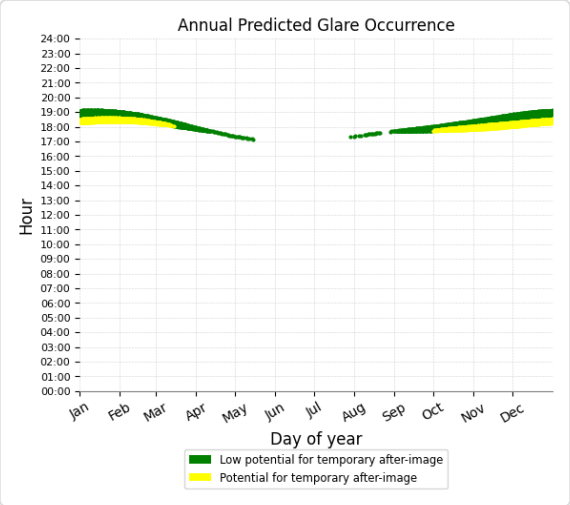
Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
Birriwa Bus Route South - Cycle Trail	4,867	81.1	2,178	36.3
Birriwa Bus Route North	40	0.7	0	0.0
Railway	61	1.0	0	0.0
Castlereigh Hwy	0	0.0	0	0.0
Golden Hwy	0	0.0	0	0.0
Merotherie Rd	0	0.0	0	0.0
OP 1	17	0.3	0	0.0
OP 2	137	2.3	0	0.0
OP 3	77	1.3	0	0.0
OP 4	30	0.5	0	0.0
OP 12	21	0.3	0	0.0
OP 13	29	0.5	0	0.0
OP 14	29	0.5	0	0.0
OP 15	30	0.5	0	0.0
OP 16	32	0.5	0	0.0
OP 17	34	0.6	0	0.0
OP 18	34	0.6	0	0.0
OP 19	33	0.6	0	0.0
OP 20	52	0.9	0	0.0
OP 22	35	0.6	0	0.0
OP 23	41	0.7	0	0.0
OP 5	0	0.0	0	0.0
OP 6	0	0.0	0	0.0
OP 7	0	0.0	0	0.0
OP 8	0	0.0	0	0.0
OP 9	0	0.0	0	0.0
OP 10	0	0.0	0	0.0
OP 11	0	0.0	0	0.0
OP 21	0	0.0	0	0.0
OP 24	0	0.0	0	0.0
OP 25	0	0.0	0	0.0
OP 26	0	0.0	0	0.0
OP 27	0	0.0	0	0.0

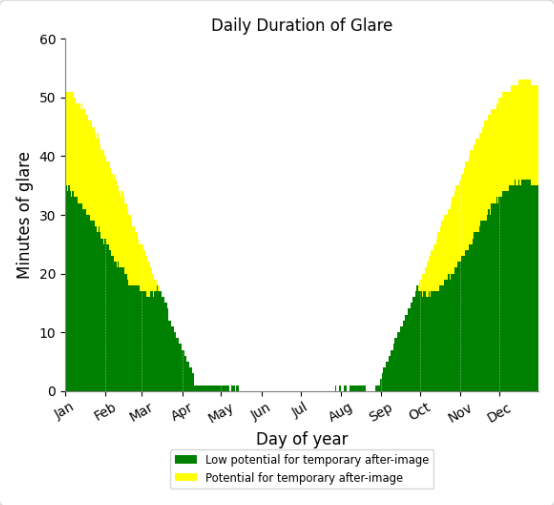
Birriwa Bus Route South - Cycle Trail

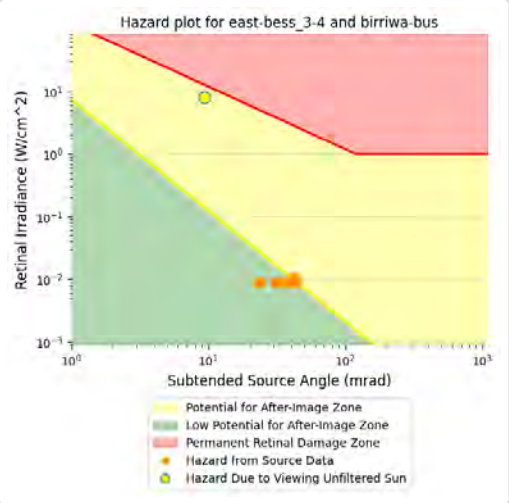
Receptor type: Route

2,178 minutes of yellow glare

4,867 minutes of green glare





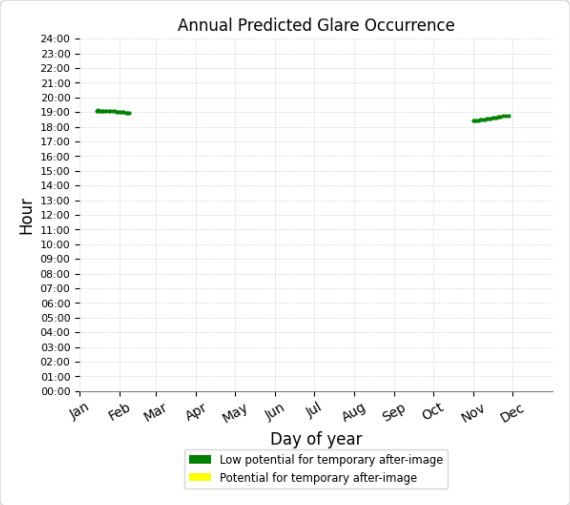


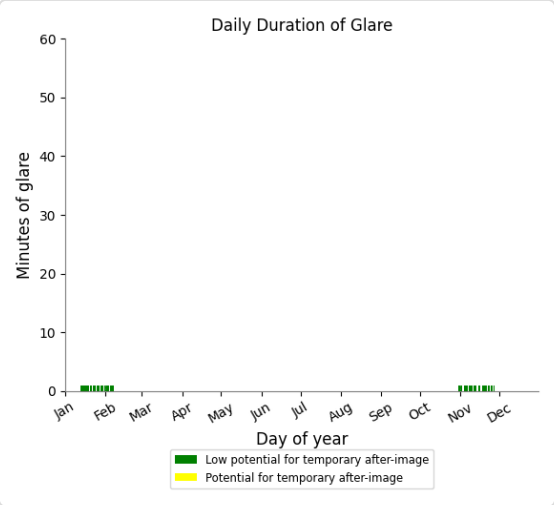
Birriwa Bus Route North

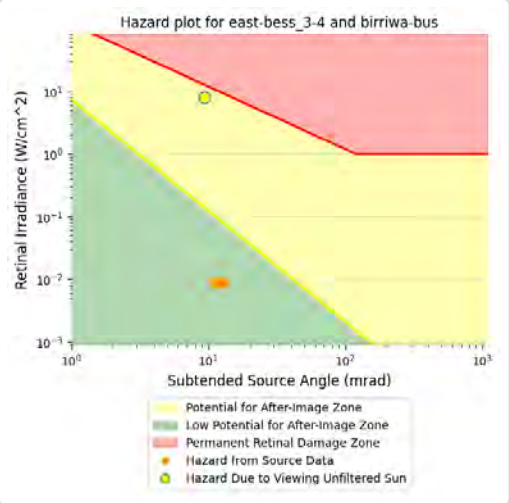
Receptor type: Route

0 minutes of yellow glare

40 minutes of green glare





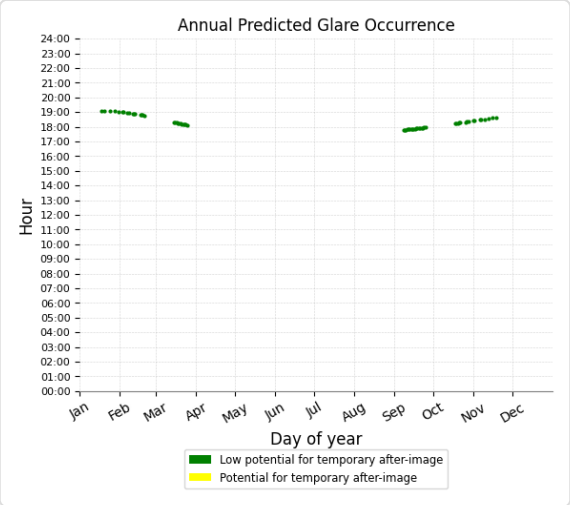


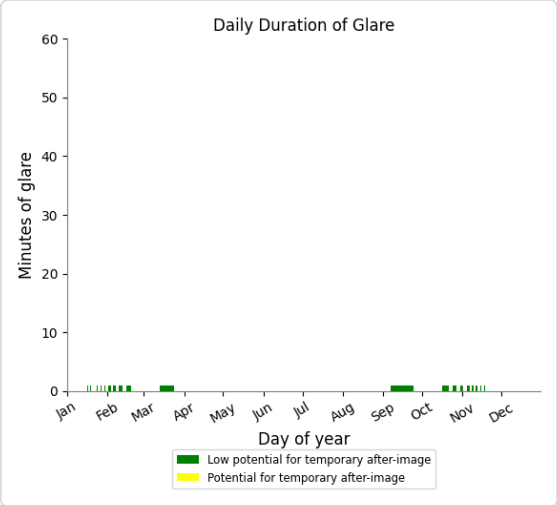
Railway

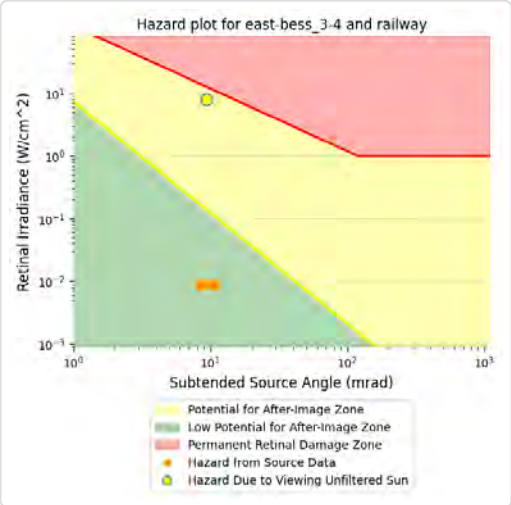
Receptor type: Route

0 minutes of yellow glare

61 minutes of green glare







Castlereigh Hwy

Receptor type: Route

No glare found

Golden Hwy

Receptor type: Route

No glare found

Merotherie Rd

Receptor type: Route

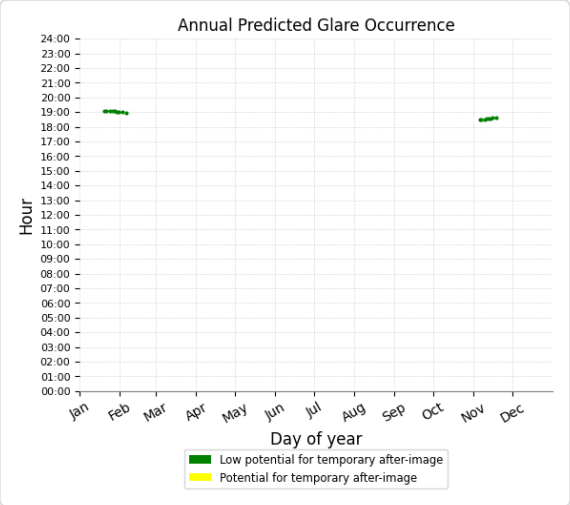
No glare found

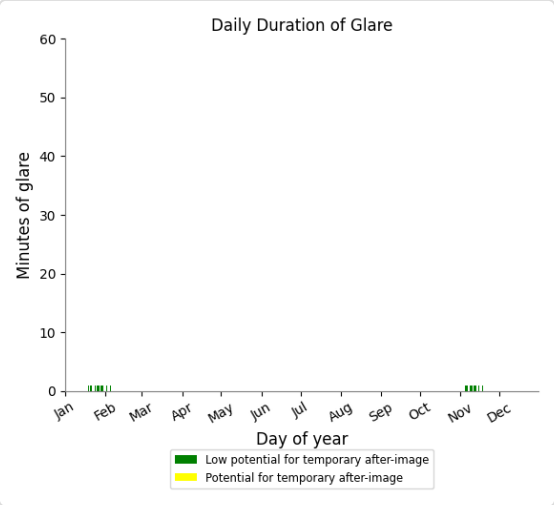
OP 1

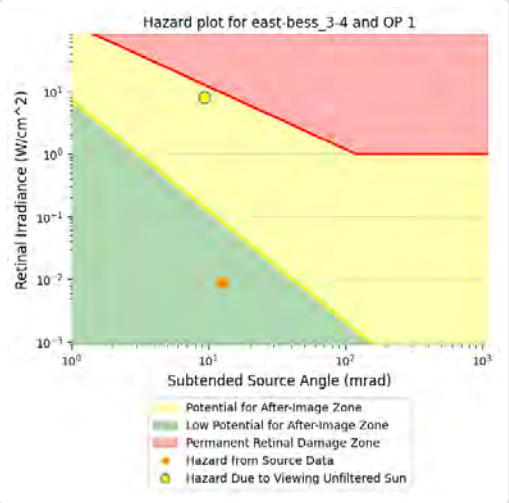
Receptor type: Observation Point

0 minutes of yellow glare

17 minutes of green glare





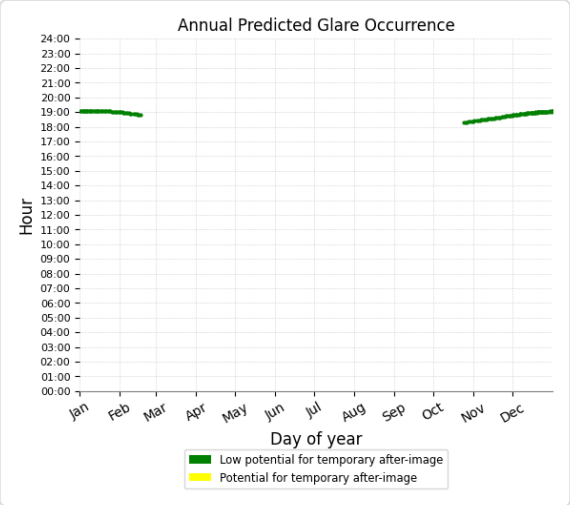


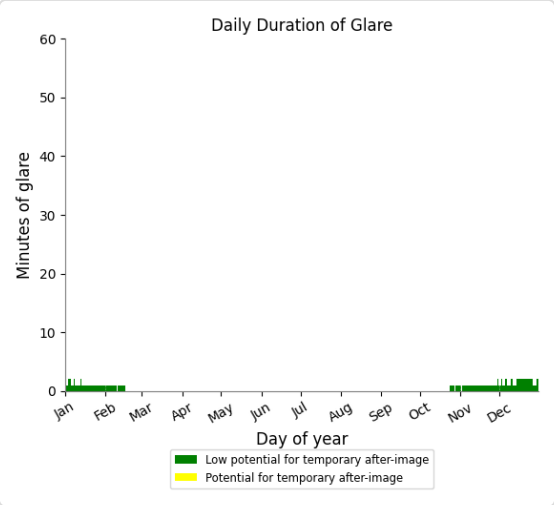
OP 2

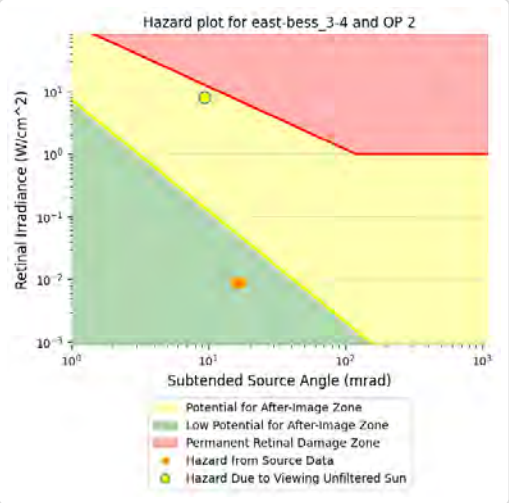
Receptor type: Observation Point

0 minutes of yellow glare

137 minutes of green glare





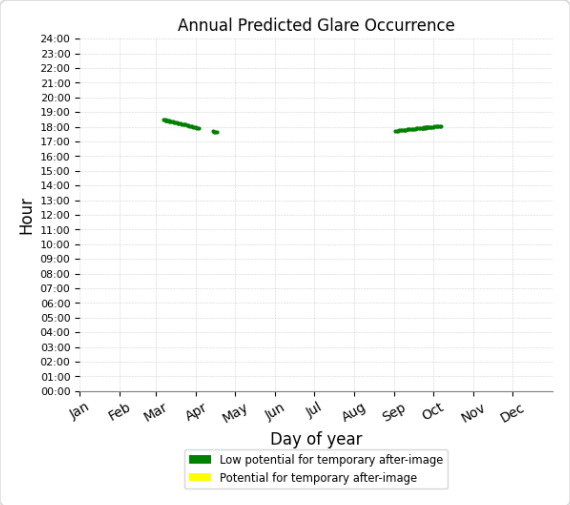


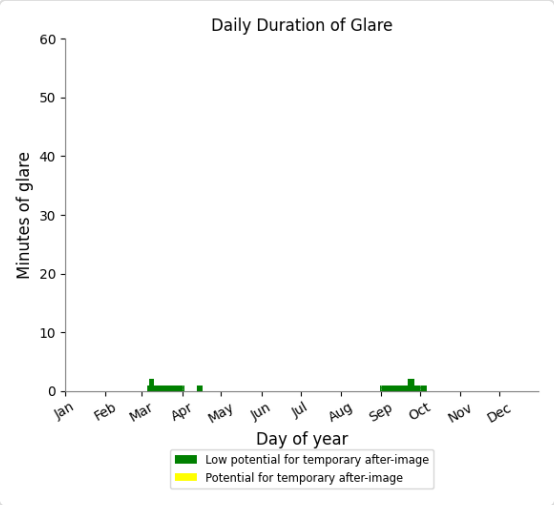
OP 3

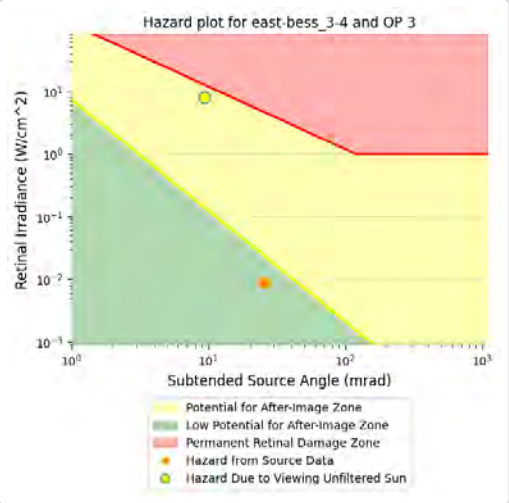
Receptor type: Observation Point

0 minutes of yellow glare

77 minutes of green glare





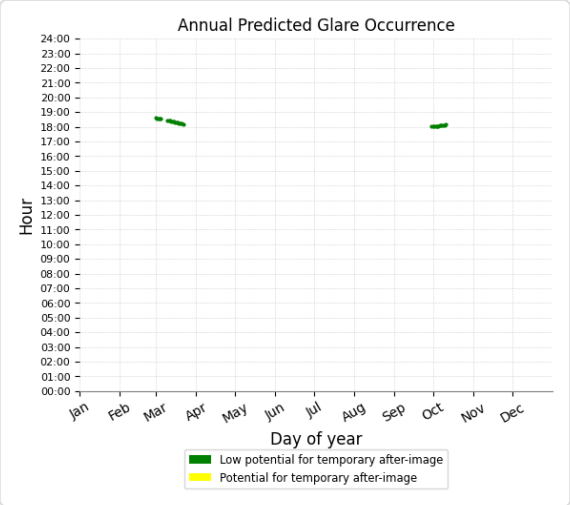


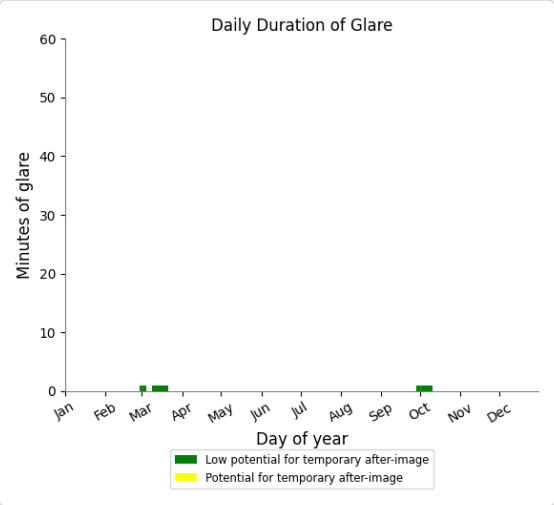
OP 4

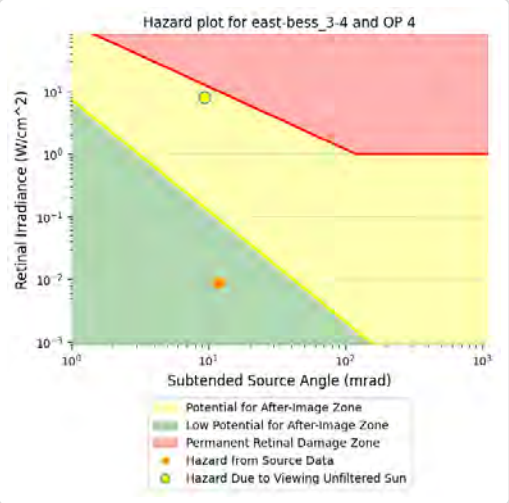
Receptor type: Observation Point

0 minutes of yellow glare

30 minutes of green glare





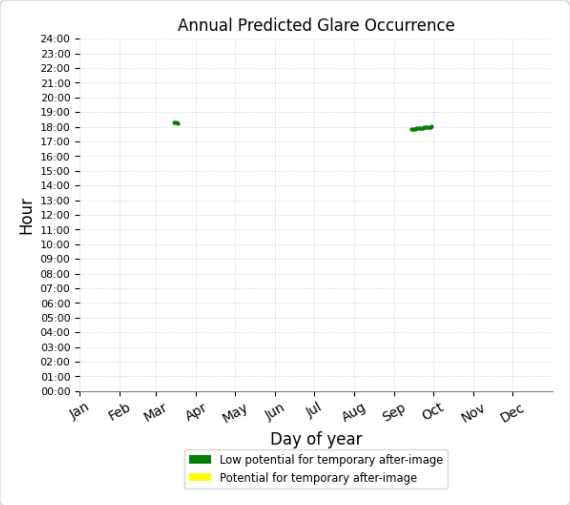


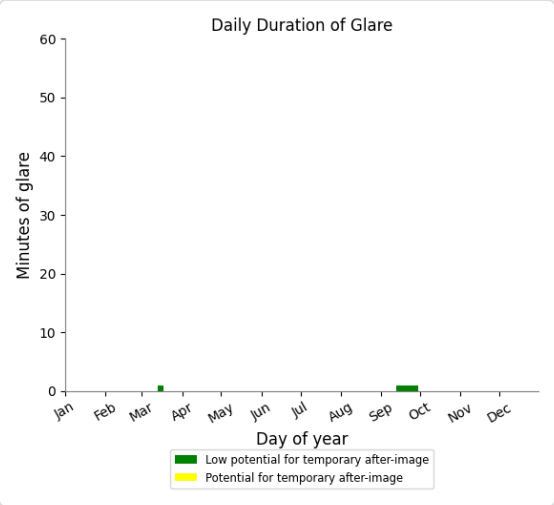
OP 12

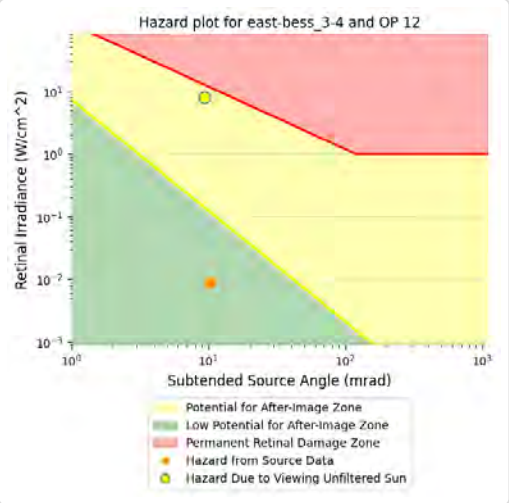
Receptor type: Observation Point

0 minutes of yellow glare

21 minutes of green glare

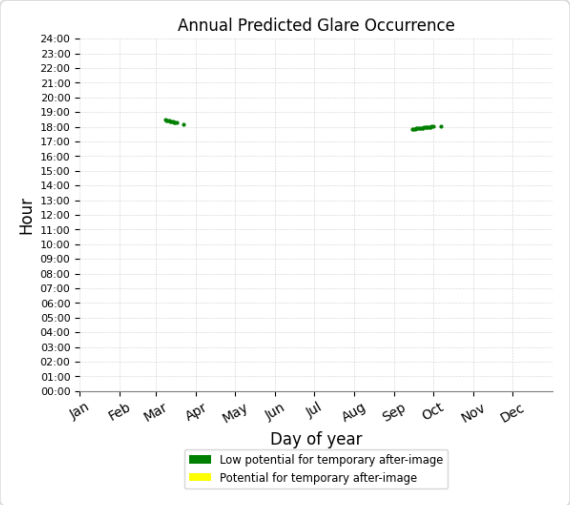


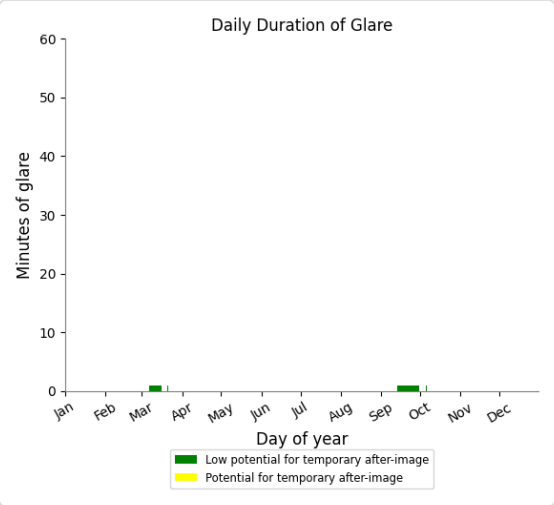


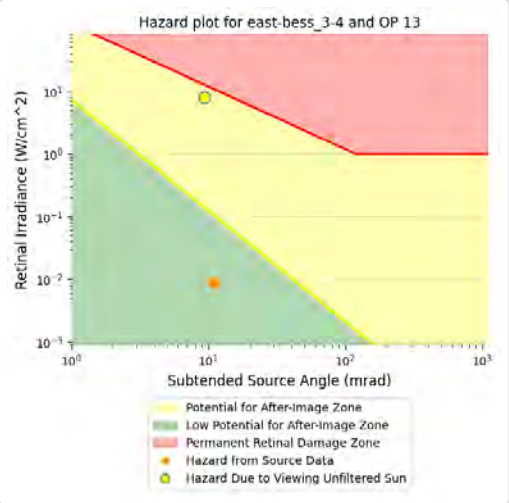


OP 13

Receptor type: Observation Point
0 minutes of yellow glare
29 minutes of green glare

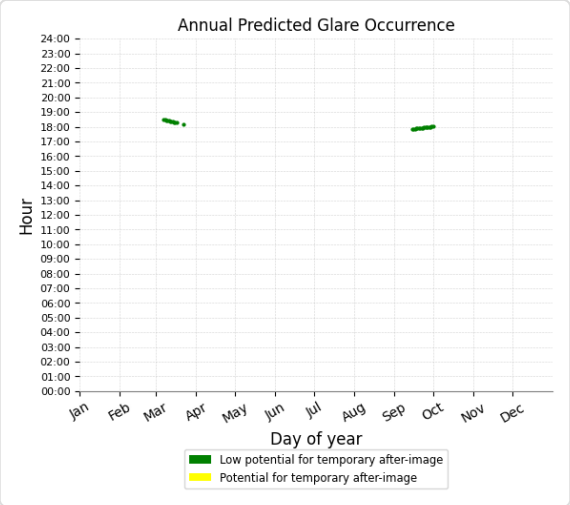


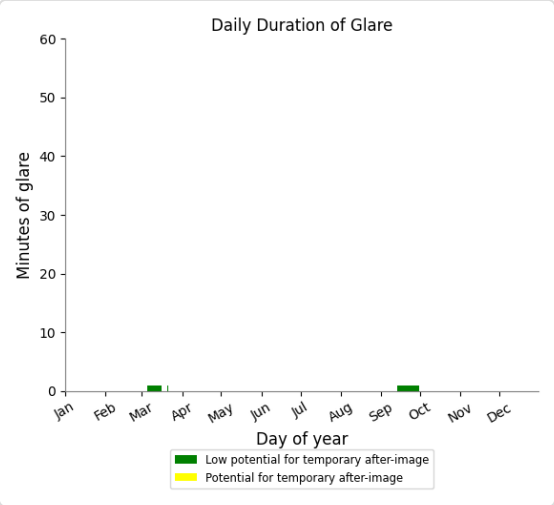


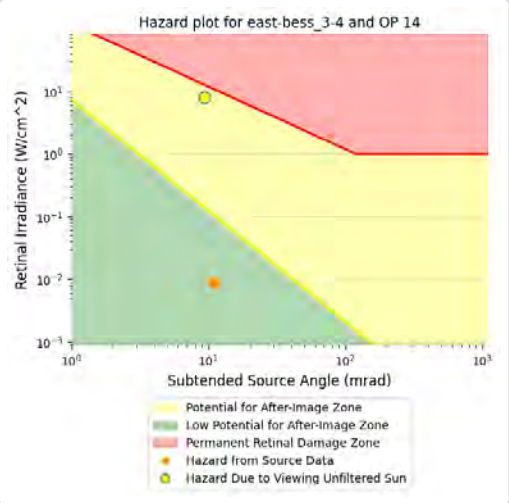


OP 14

Receptor type: Observation Point
0 minutes of yellow glare
29 minutes of green glare

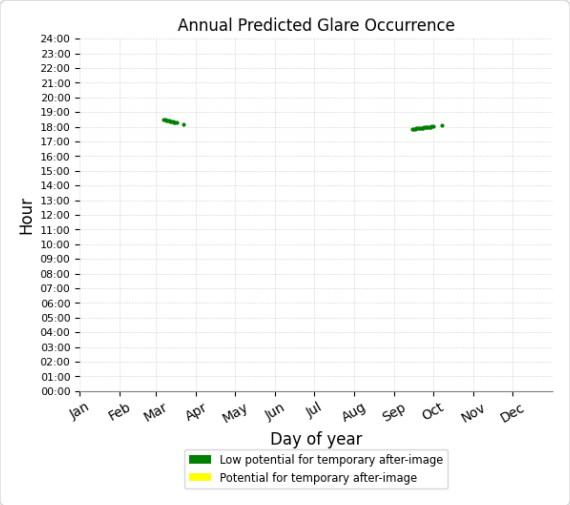


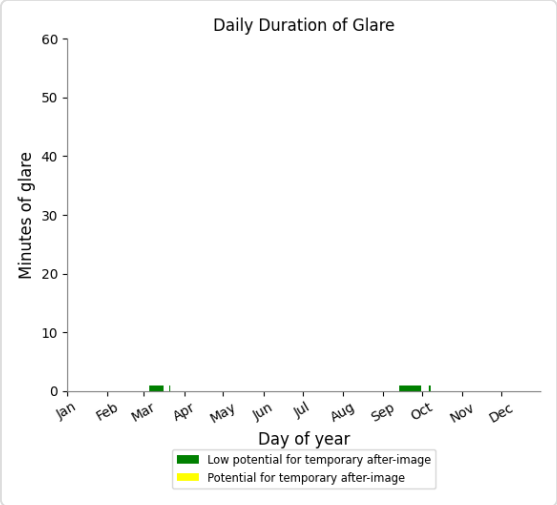


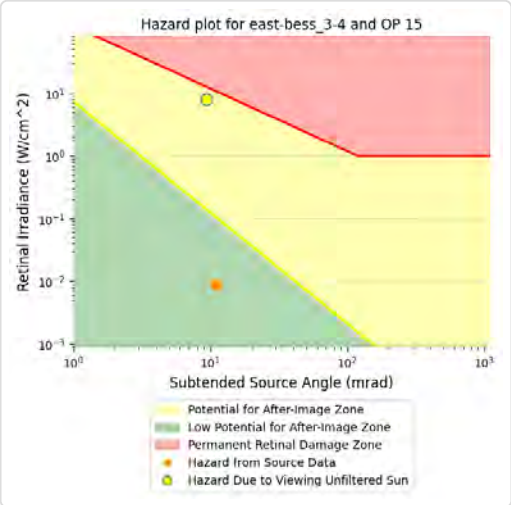


OP 15

Receptor type: Observation Point
0 minutes of yellow glare
30 minutes of green glare





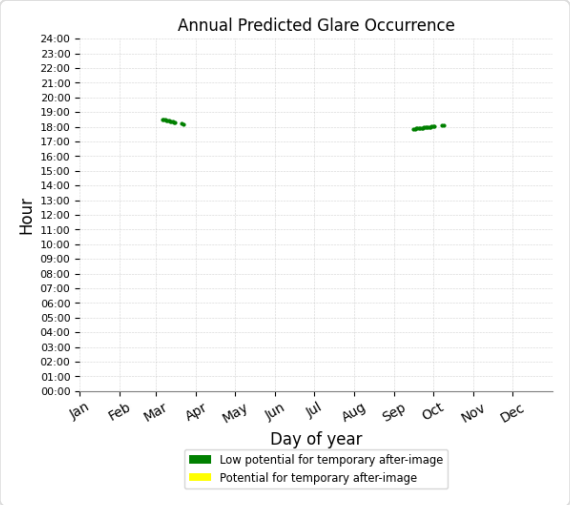


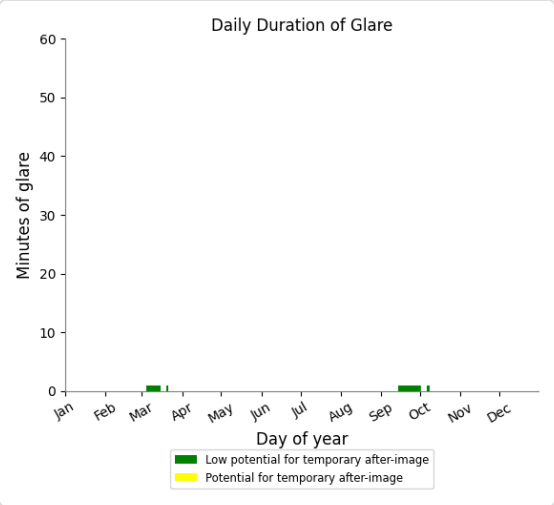
OP 16

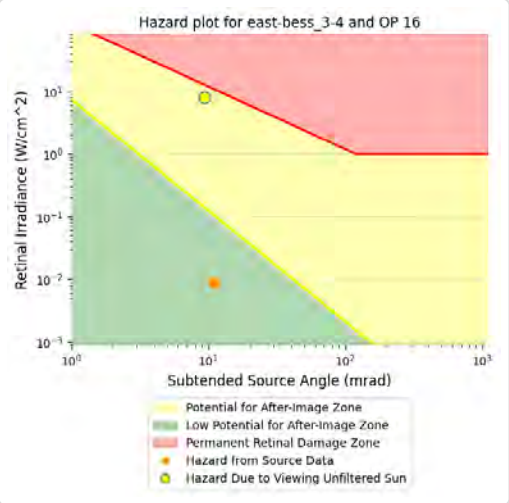
Receptor type: Observation Point

0 minutes of yellow glare

32 minutes of green glare





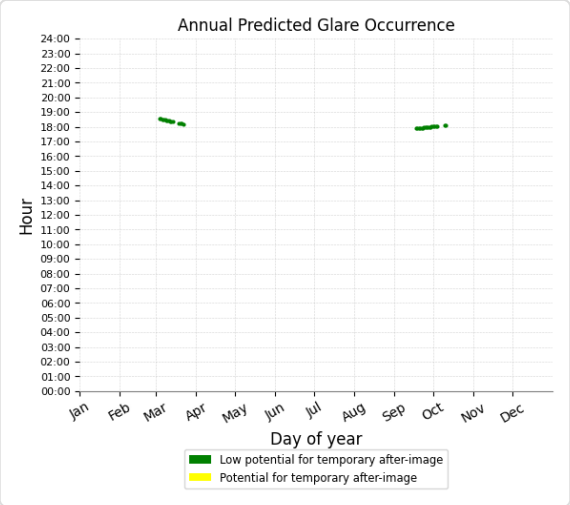


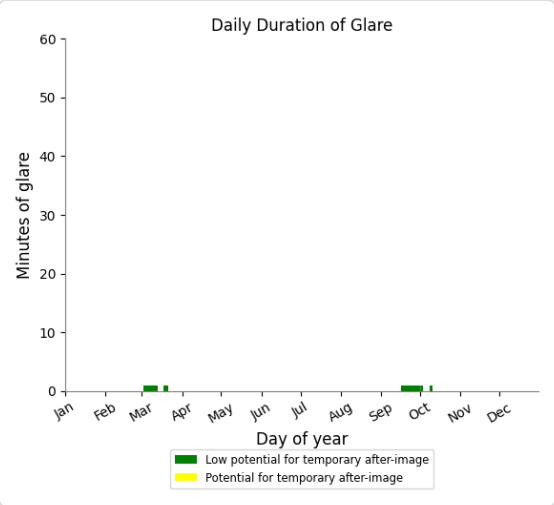
OP 17

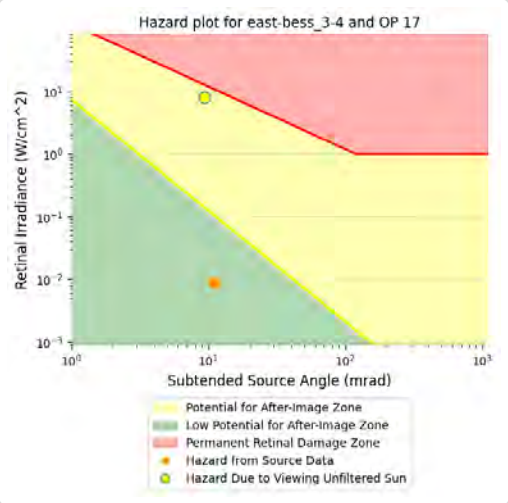
Receptor type: Observation Point

0 minutes of yellow glare

34 minutes of green glare





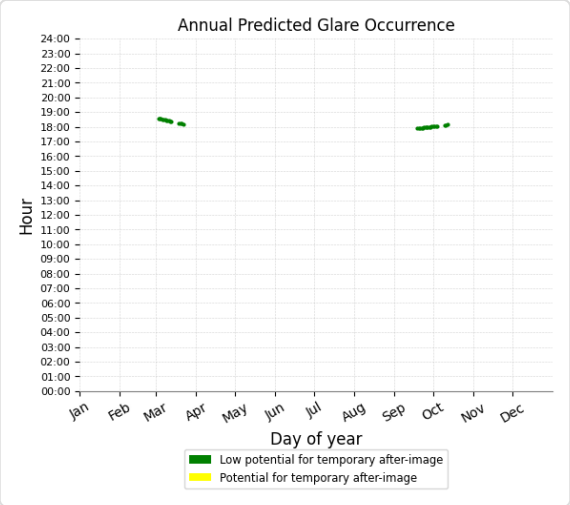


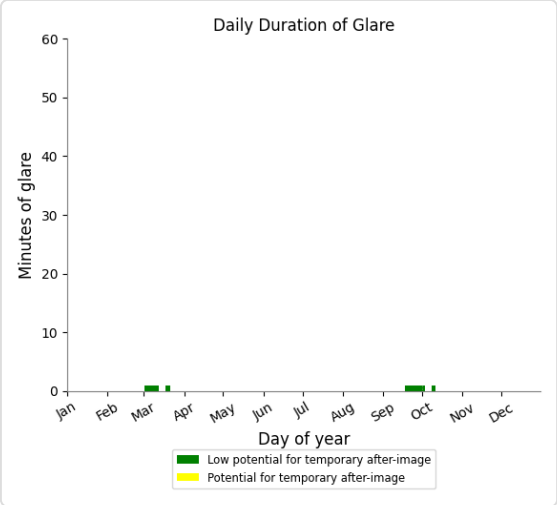
OP 18

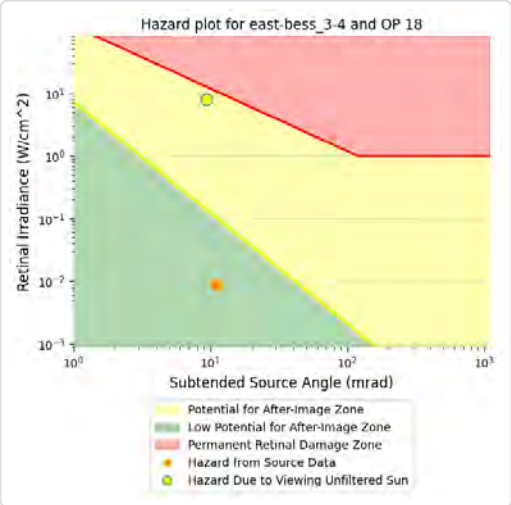
Receptor type: Observation Point

0 minutes of yellow glare

34 minutes of green glare

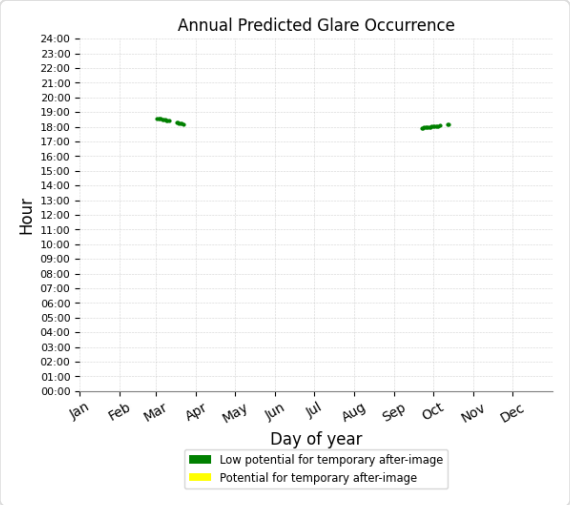


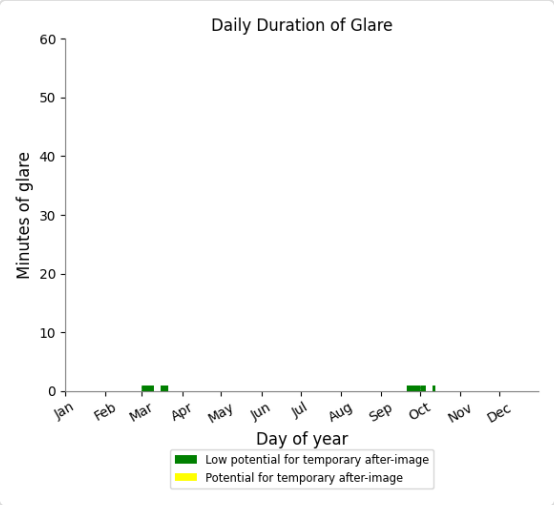


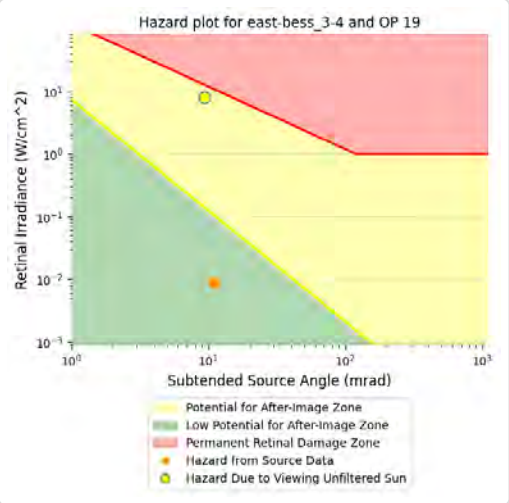


OP 19

Receptor type: Observation Point
0 minutes of yellow glare
33 minutes of green glare





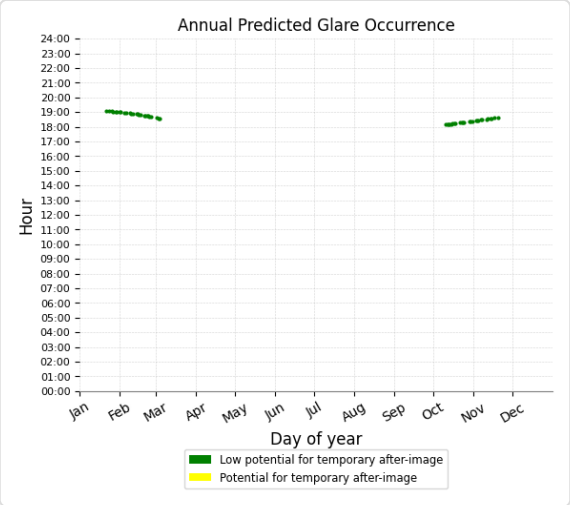


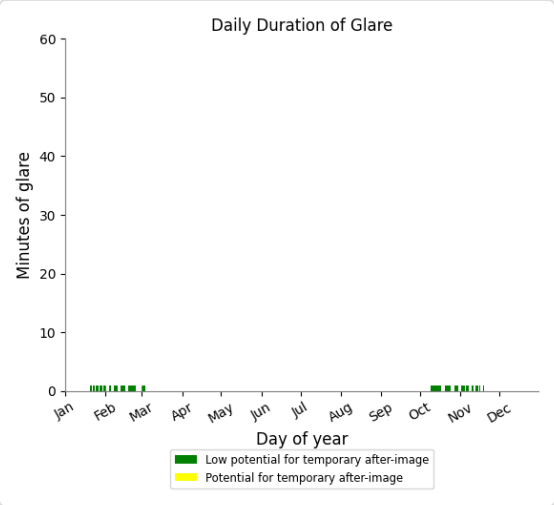
OP 20

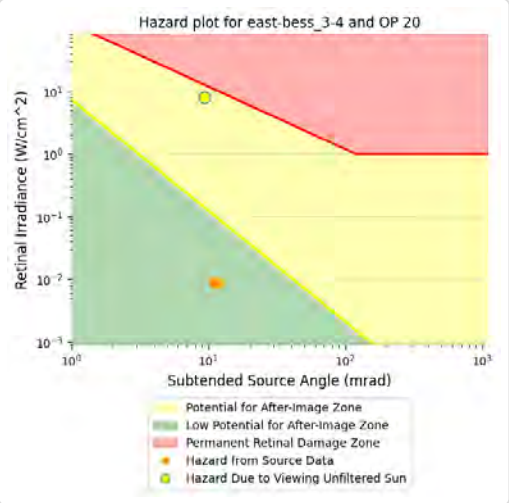
Receptor type: Observation Point

0 minutes of yellow glare

52 minutes of green glare





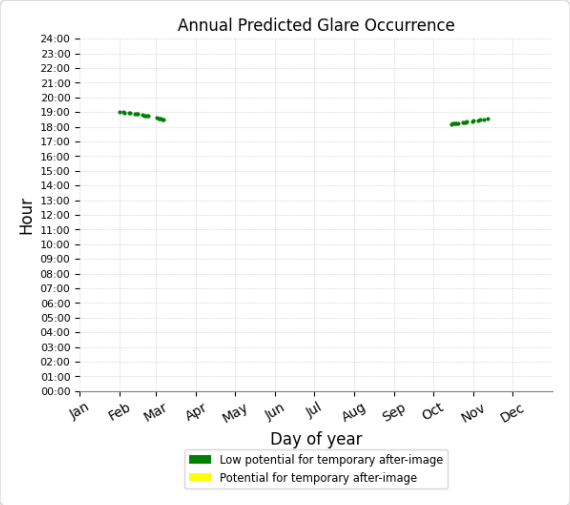


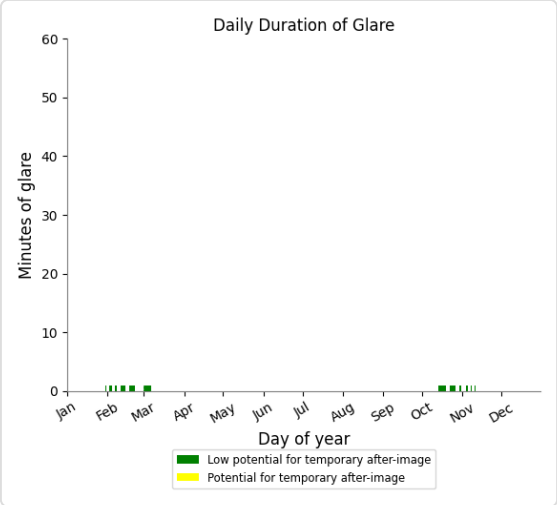
OP 22

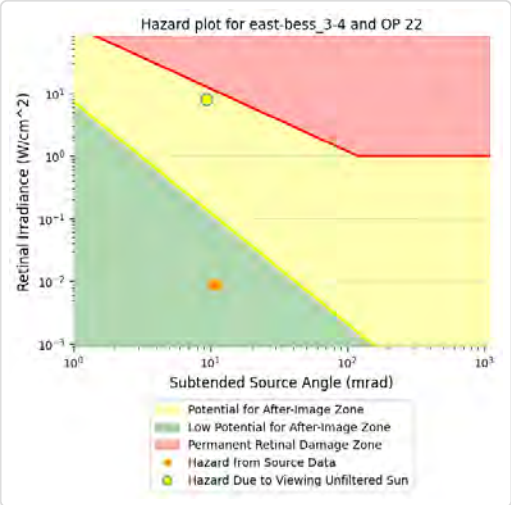
Receptor type: Observation Point

0 minutes of yellow glare

35 minutes of green glare

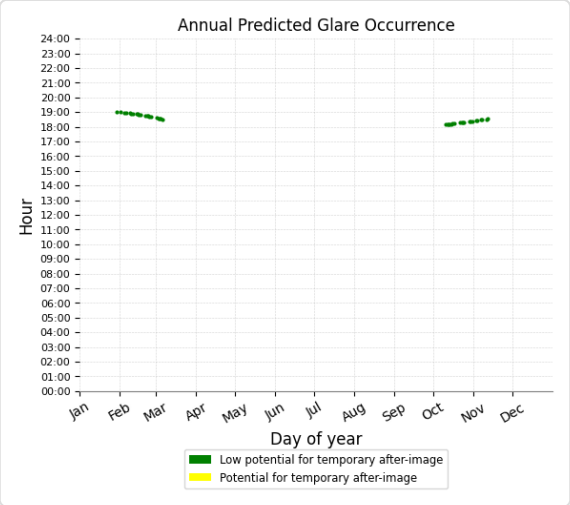


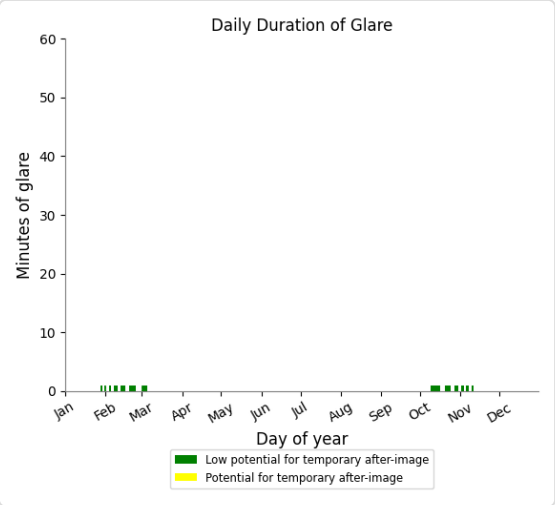


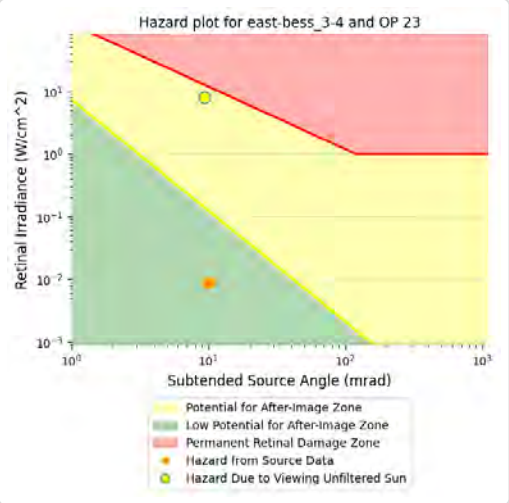


OP 23

Receptor type: Observation Point
0 minutes of yellow glare
41 minutes of green glare







OP 5

Receptor type: Observation Point
No glare found

OP 6

Receptor type: Observation Point
No glare found

OP 7

Receptor type: Observation Point
No glare found

OP 8

Receptor type: Observation Point
No glare found

OP 9

Receptor type: Observation Point
No glare found

OP 10

Receptor type: Observation Point
No glare found

OP 11

Receptor type: Observation Point
No glare found

OP 21

Receptor type: Observation Point
No glare found

OP 24

Receptor type: Observation Point
No glare found

OP 25

Receptor type: Observation Point
No glare found

OP 26

Receptor type: Observation Point
No glare found

OP 27

Receptor type: Observation Point
No glare found

VS Face: 4-5 low potential for temporary after-image

Receptor results ordered by category of glare

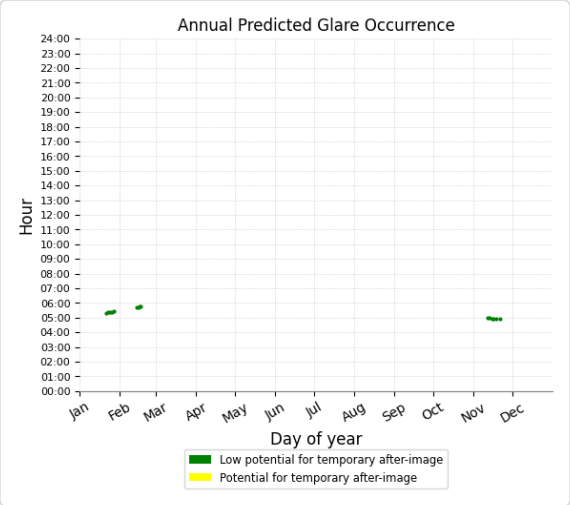
Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
Birriwa Bus Route South - Cycle Trail	15	0.2	0	0.0
Merotherie Rd	14	0.2	0	0.0
Birriwa Bus Route North	0	0.0	0	0.0
Castlereigh Hwy	0	0.0	0	0.0
Golden Hwy	0	0.0	0	0.0
Railway	0	0.0	0	0.0
OP 1	0	0.0	0	0.0
OP 2	0	0.0	0	0.0
OP 3	0	0.0	0	0.0
OP 4	0	0.0	0	0.0
OP 5	0	0.0	0	0.0
OP 6	0	0.0	0	0.0
OP 7	0	0.0	0	0.0
OP 8	0	0.0	0	0.0
OP 9	0	0.0	0	0.0
OP 10	0	0.0	0	0.0
OP 11	0	0.0	0	0.0
OP 12	0	0.0	0	0.0
OP 13	0	0.0	0	0.0
OP 14	0	0.0	0	0.0
OP 15	0	0.0	0	0.0
OP 16	0	0.0	0	0.0
OP 17	0	0.0	0	0.0
OP 18	0	0.0	0	0.0
OP 19	0	0.0	0	0.0
OP 20	0	0.0	0	0.0
OP 21	0	0.0	0	0.0
OP 22	0	0.0	0	0.0
OP 23	0	0.0	0	0.0
OP 24	0	0.0	0	0.0
OP 25	0	0.0	0	0.0
OP 26	0	0.0	0	0.0
OP 27	0	0.0	0	0.0

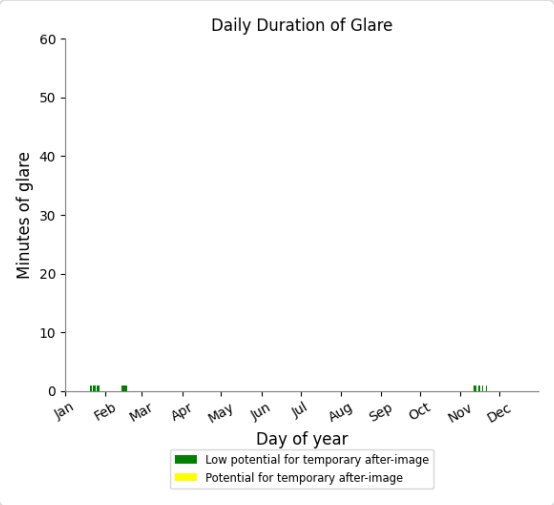
Birriwa Bus Route South - Cycle Trail

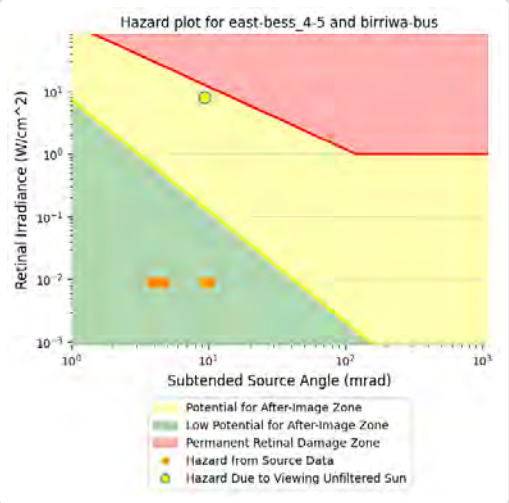
Receptor type: Route

0 minutes of yellow glare

15 minutes of green glare

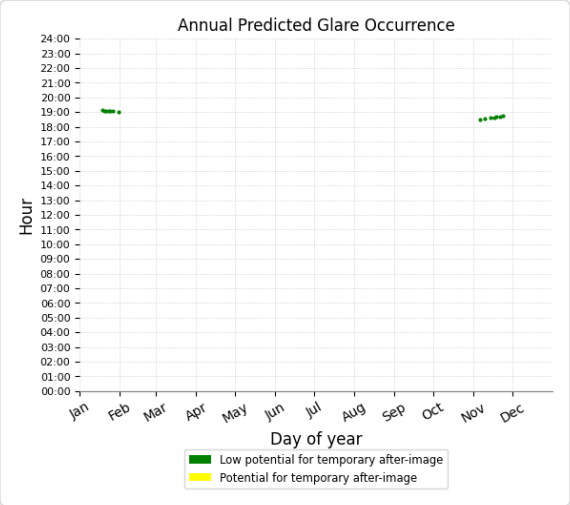


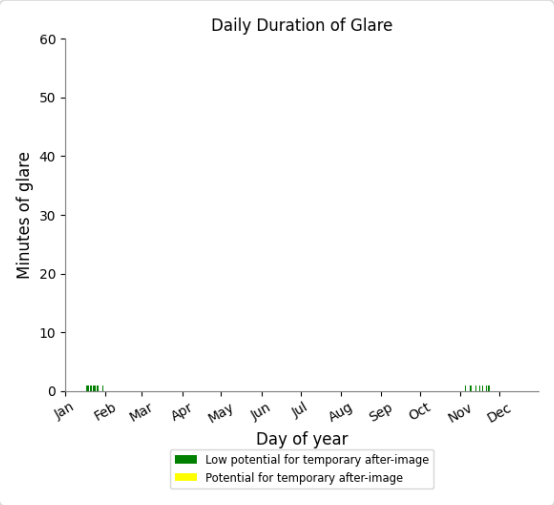


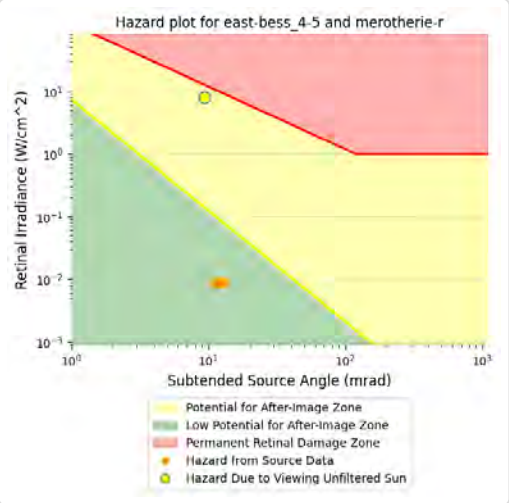


Merotherie Rd

Receptor type: Route
0 minutes of yellow glare
14 minutes of green glare







Birriwa Bus Route North

Receptor type: Route
No glare found

Castlereigh Hwy

Receptor type: Route
No glare found

Golden Hwy

Receptor type: Route
No glare found

Railway

Receptor type: Route
No glare found

OP 1

Receptor type: Observation Point
No glare found

OP 2

Receptor type: Observation Point
No glare found

OP 3

Receptor type: Observation Point
No glare found

OP 4

Receptor type: Observation Point
No glare found

OP 5

Receptor type: Observation Point
No glare found

OP 6

Receptor type: Observation Point
No glare found

OP 7

Receptor type: Observation Point
No glare found

OP 8

Receptor type: Observation Point
No glare found

OP 9

Receptor type: Observation Point
No glare found

OP 10

Receptor type: Observation Point
No glare found

OP 11

Receptor type: Observation Point
No glare found

OP 12

Receptor type: Observation Point
No glare found

OP 13

Receptor type: Observation Point
No glare found

OP 14

Receptor type: Observation Point
No glare found

OP 15

Receptor type: Observation Point
No glare found

OP 16

Receptor type: Observation Point
No glare found

OP 17

Receptor type: Observation Point
No glare found

OP 18

Receptor type: Observation Point
No glare found

OP 19

Receptor type: Observation Point
No glare found

OP 20

Receptor type: Observation Point
No glare found

OP 21

Receptor type: Observation Point
No glare found

OP 22

Receptor type: Observation Point
No glare found

OP 23

Receptor type: Observation Point
No glare found

OP 24

Receptor type: Observation Point
No glare found

OP 25

Receptor type: Observation Point
No glare found

OP 26

Receptor type: Observation Point
No glare found

OP 27

Receptor type: Observation Point
No glare found

VS: West BESS

VS Face: 1-2 low potential for temporary after-image

Receptor results ordered by category of glare

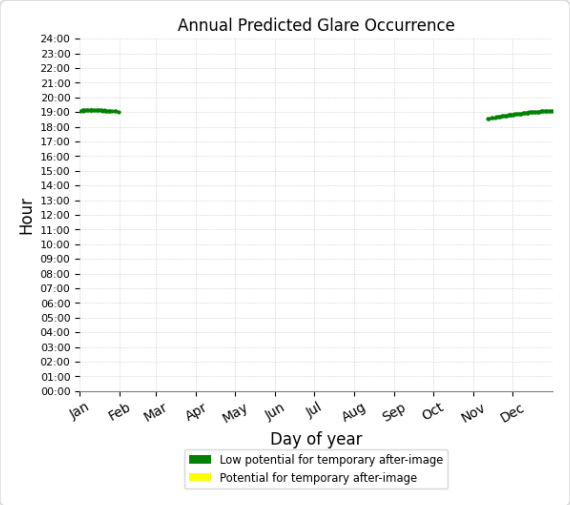
Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
Birriwa Bus Route South - Cycle Trail	81	1.4	0	0.0
Railway	40	0.7	0	0.0
Birriwa Bus Route North	0	0.0	0	0.0
Castlereigh Hwy	0	0.0	0	0.0
Golden Hwy	0	0.0	0	0.0
Merotherie Rd	0	0.0	0	0.0
OP 13	11	0.2	0	0.0
OP 14	12	0.2	0	0.0
OP 15	13	0.2	0	0.0
OP 16	13	0.2	0	0.0
OP 17	14	0.2	0	0.0
OP 18	20	0.3	0	0.0
OP 19	15	0.2	0	0.0
OP 1	0	0.0	0	0.0
OP 2	0	0.0	0	0.0
OP 3	0	0.0	0	0.0
OP 4	0	0.0	0	0.0
OP 5	0	0.0	0	0.0
OP 6	0	0.0	0	0.0
OP 7	0	0.0	0	0.0
OP 8	0	0.0	0	0.0
OP 9	0	0.0	0	0.0
OP 10	0	0.0	0	0.0
OP 11	0	0.0	0	0.0
OP 12	0	0.0	0	0.0
OP 20	0	0.0	0	0.0
OP 21	0	0.0	0	0.0
OP 22	0	0.0	0	0.0
OP 23	0	0.0	0	0.0
OP 24	0	0.0	0	0.0
OP 25	0	0.0	0	0.0
OP 26	0	0.0	0	0.0
OP 27	0	0.0	0	0.0

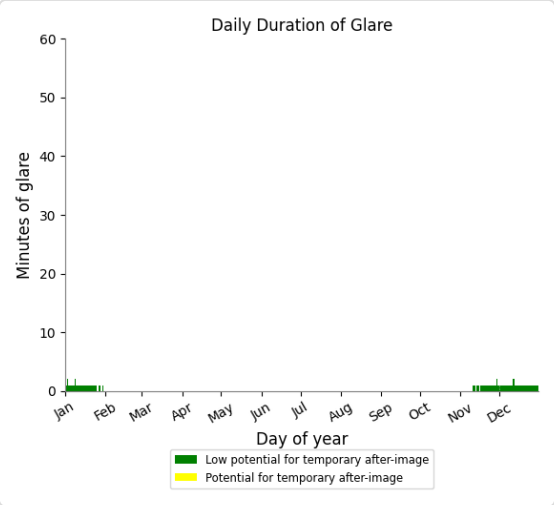
Birriwa Bus Route South - Cycle Trail

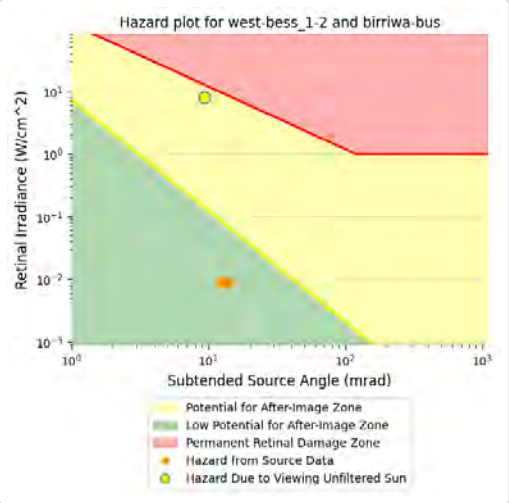
Receptor type: Route

0 minutes of yellow glare

81 minutes of green glare





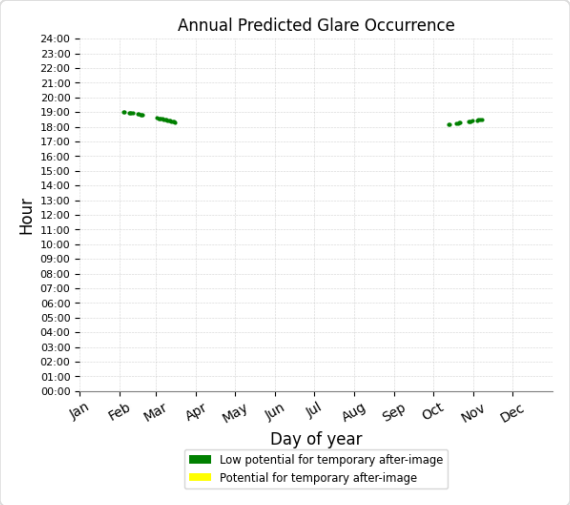


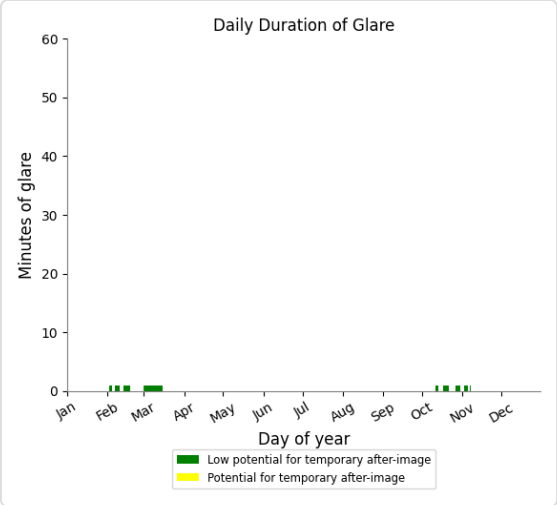
Railway

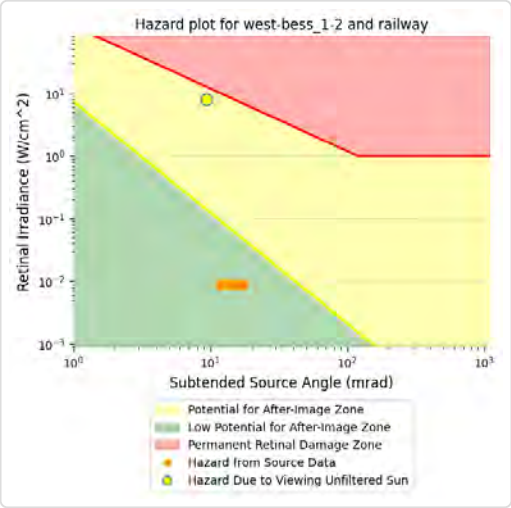
Receptor type: Route

0 minutes of yellow glare

40 minutes of green glare







Birriwa Bus Route North

Receptor type: Route

No glare found

Castlereigh Hwy

Receptor type: Route

No glare found

Golden Hwy

Receptor type: Route

No glare found

Merotherie Rd

Receptor type: Route

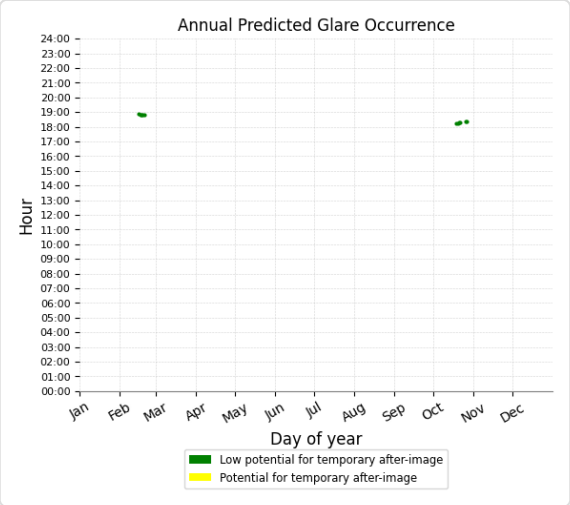
No glare found

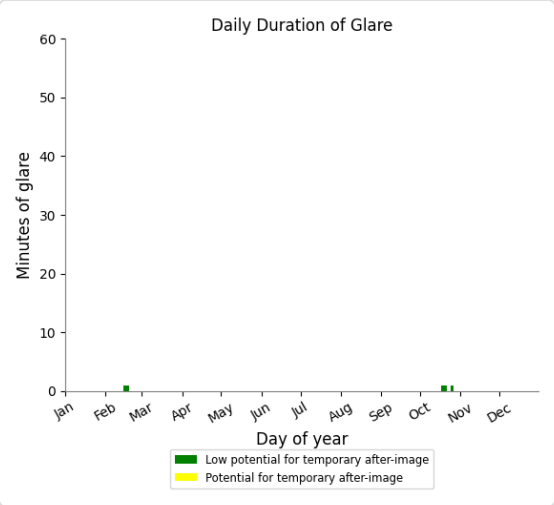
OP 13

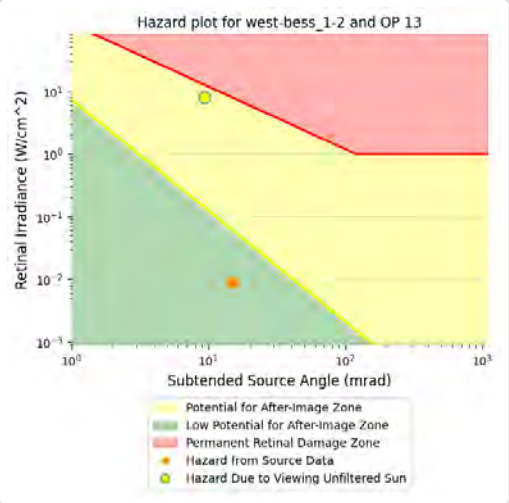
Receptor type: Observation Point

0 minutes of yellow glare

11 minutes of green glare

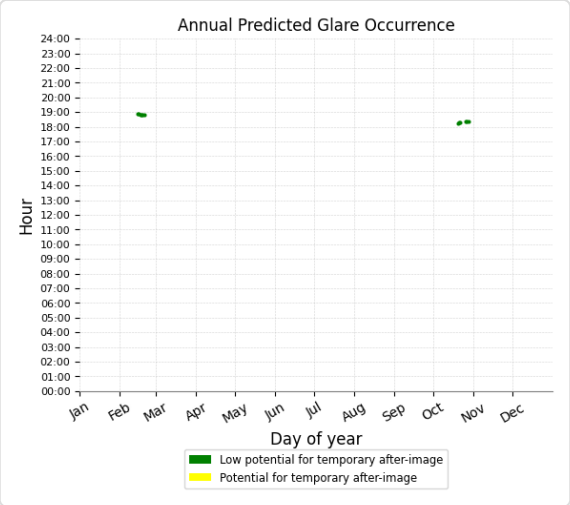


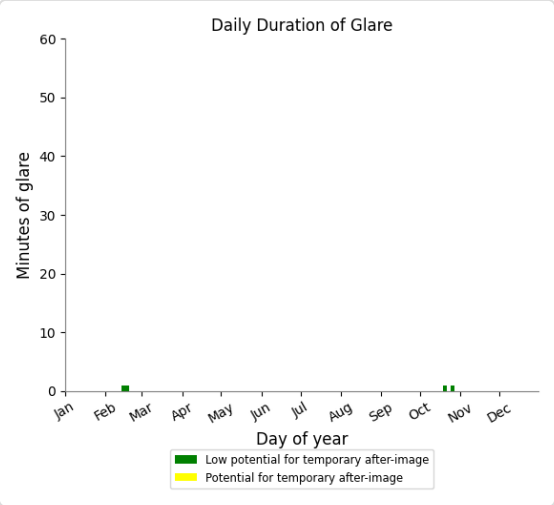


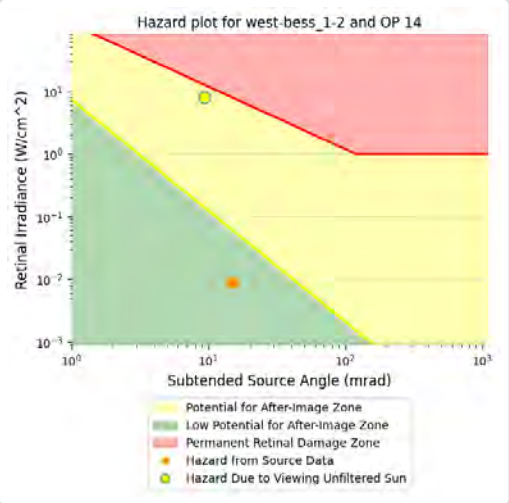


OP 14

Receptor type: Observation Point
0 minutes of yellow glare
12 minutes of green glare





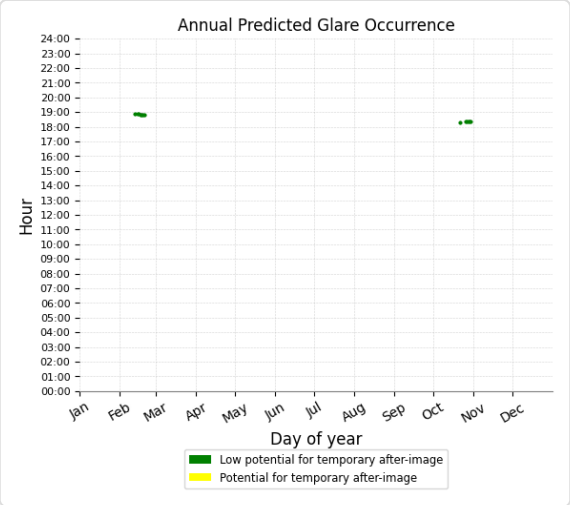


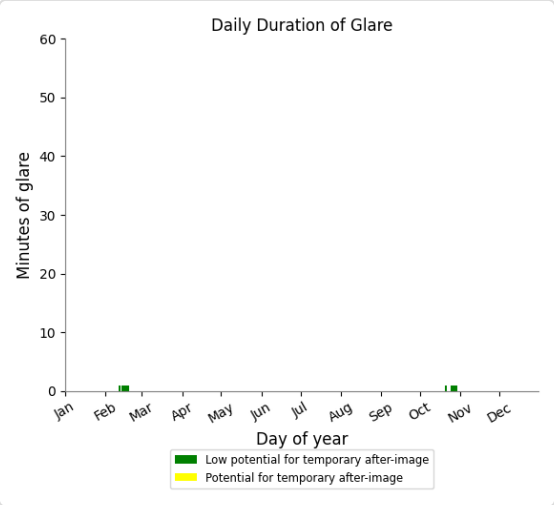
OP 15

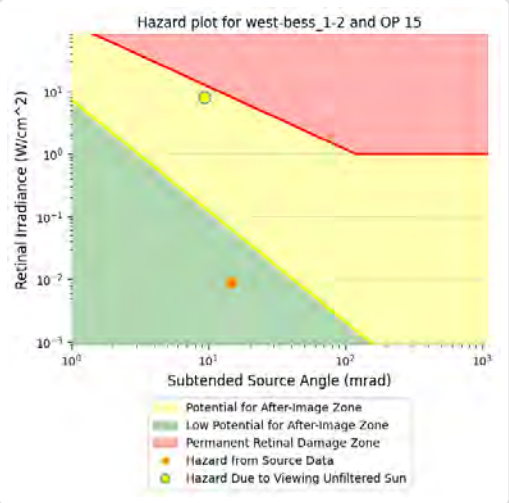
Receptor type: Observation Point

0 minutes of yellow glare

13 minutes of green glare





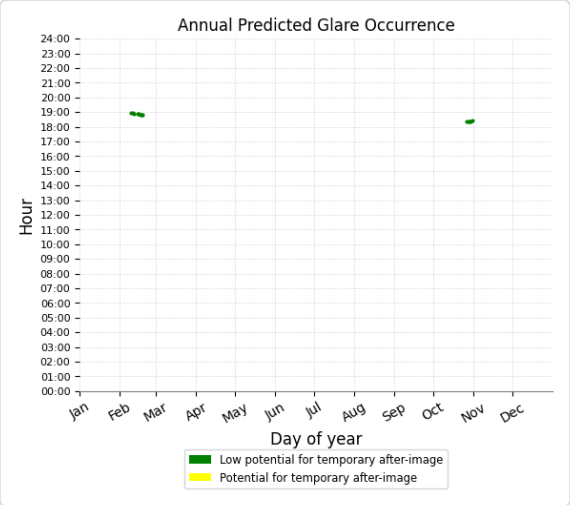


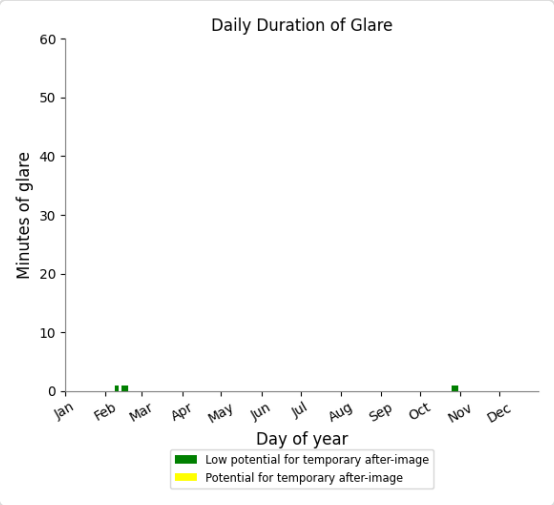
OP 16

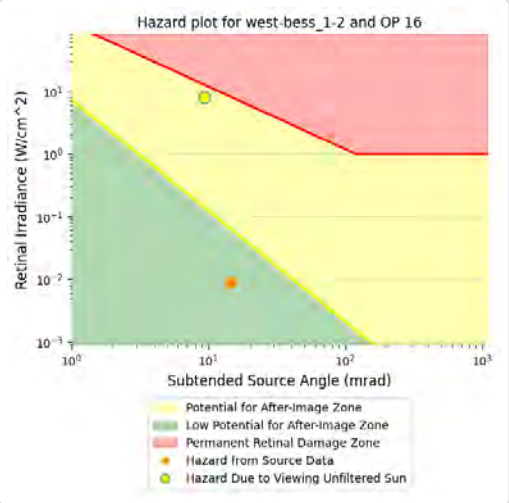
Receptor type: Observation Point

0 minutes of yellow glare

13 minutes of green glare





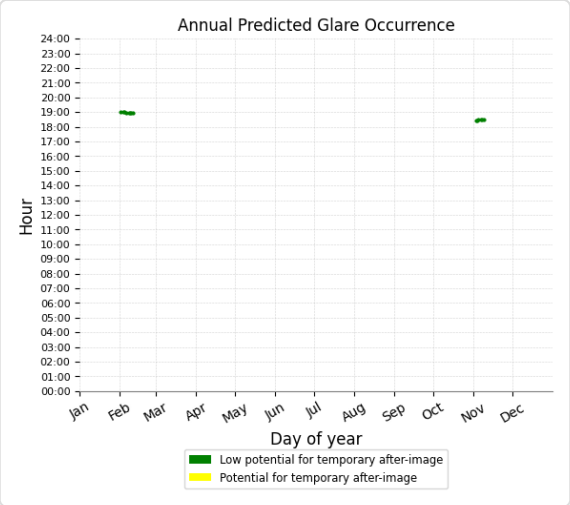


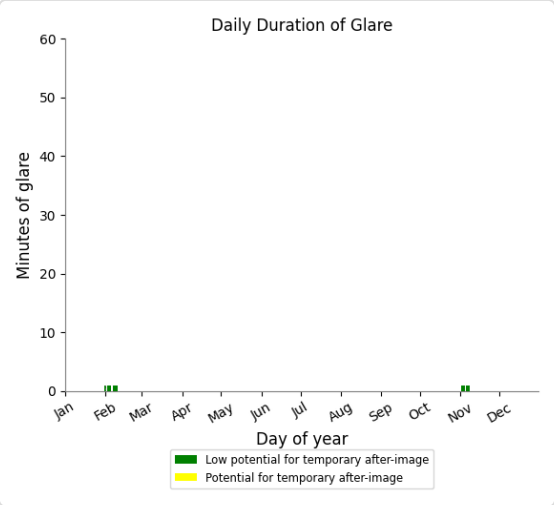
OP 17

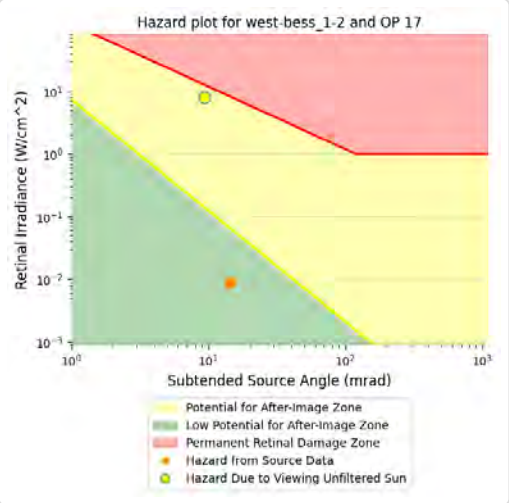
Receptor type: Observation Point

0 minutes of yellow glare

14 minutes of green glare





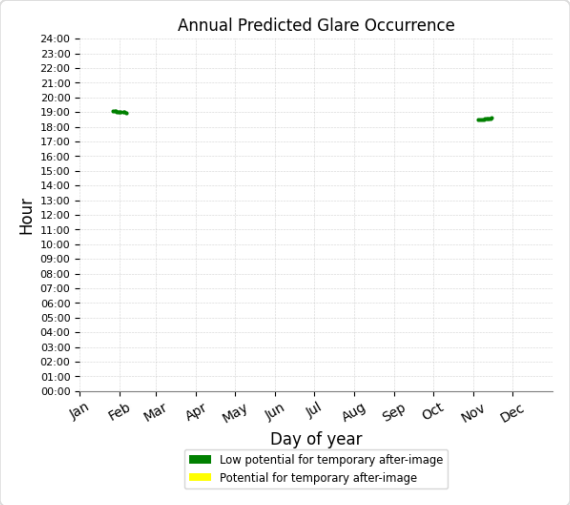


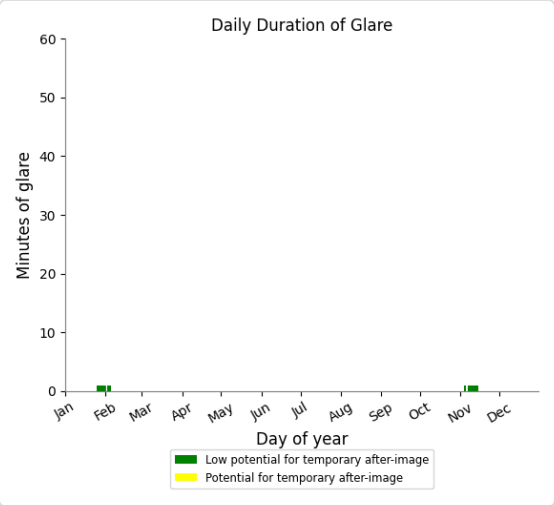
OP 18

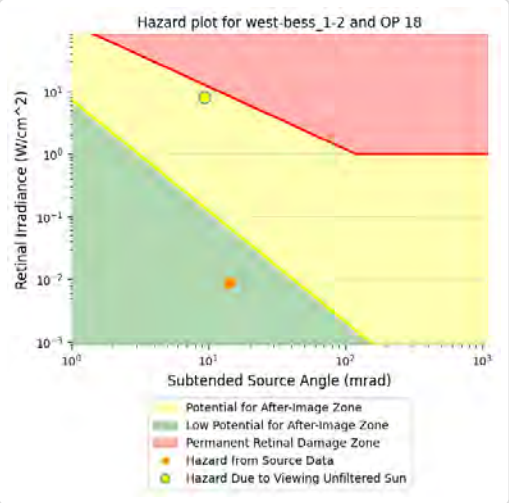
Receptor type: Observation Point

0 minutes of yellow glare

20 minutes of green glare

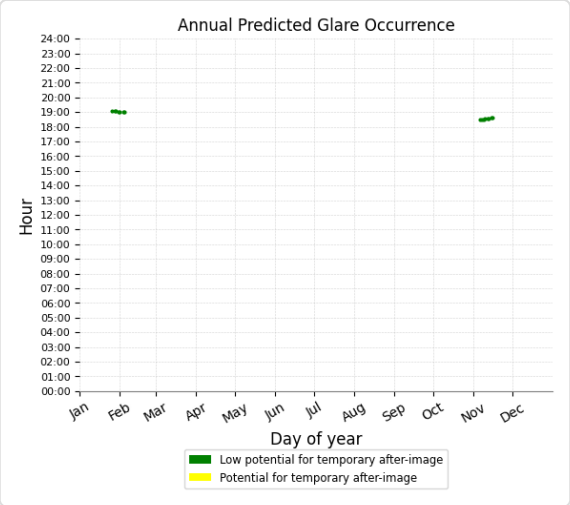


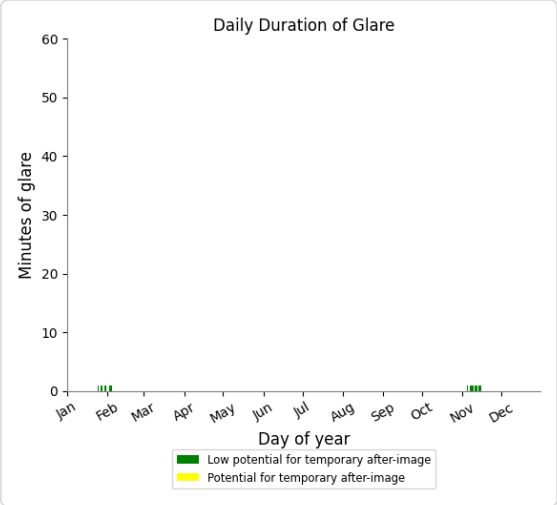


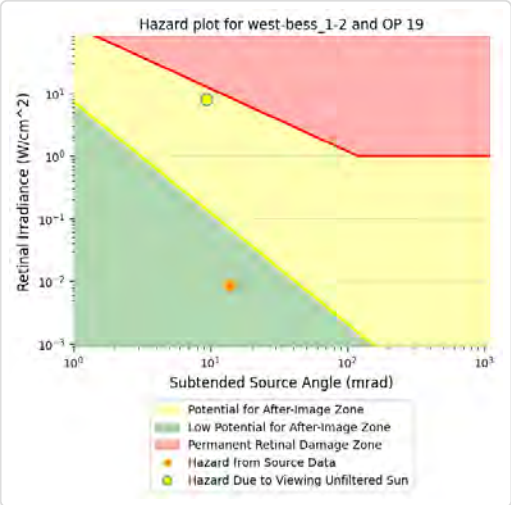


OP 19

Receptor type: Observation Point
0 minutes of yellow glare
15 minutes of green glare







OP 1

Receptor type: Observation Point
No glare found

OP 2

Receptor type: Observation Point
No glare found

OP 3

Receptor type: Observation Point
No glare found

OP 4

Receptor type: Observation Point
No glare found

OP 5

Receptor type: Observation Point
No glare found

OP 6

Receptor type: Observation Point
No glare found

OP 7

Receptor type: Observation Point
No glare found

OP 8

Receptor type: Observation Point
No glare found

OP 9

Receptor type: Observation Point
No glare found

OP 10

Receptor type: Observation Point
No glare found

OP 11

Receptor type: Observation Point
No glare found

OP 12

Receptor type: Observation Point
No glare found

OP 20

Receptor type: Observation Point
No glare found

OP 21

Receptor type: Observation Point
No glare found

OP 22

Receptor type: Observation Point
No glare found

OP 23

Receptor type: Observation Point
No glare found

OP 24

Receptor type: Observation Point
No glare found

OP 25

Receptor type: Observation Point
No glare found

OP 26

Receptor type: Observation Point
No glare found

OP 27

Receptor type: Observation Point
No glare found

VS Face: 2-3 no glare found

Receptor results ordered by category of glare

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
Birriwa Bus Route North	0	0.0	0	0.0
Birriwa Bus Route South - Cycle Trail	0	0.0	0	0.0
Castlereigh Hwy	0	0.0	0	0.0
Golden Hwy	0	0.0	0	0.0
Merotherie Rd	0	0.0	0	0.0
Railway	0	0.0	0	0.0
OP 1	0	0.0	0	0.0
OP 2	0	0.0	0	0.0
OP 3	0	0.0	0	0.0
OP 4	0	0.0	0	0.0
OP 5	0	0.0	0	0.0
OP 6	0	0.0	0	0.0
OP 7	0	0.0	0	0.0
OP 8	0	0.0	0	0.0
OP 9	0	0.0	0	0.0
OP 10	0	0.0	0	0.0
OP 11	0	0.0	0	0.0
OP 12	0	0.0	0	0.0
OP 13	0	0.0	0	0.0
OP 14	0	0.0	0	0.0
OP 15	0	0.0	0	0.0
OP 16	0	0.0	0	0.0
OP 17	0	0.0	0	0.0
OP 18	0	0.0	0	0.0
OP 19	0	0.0	0	0.0
OP 20	0	0.0	0	0.0
OP 21	0	0.0	0	0.0
OP 22	0	0.0	0	0.0
OP 23	0	0.0	0	0.0
OP 24	0	0.0	0	0.0
OP 25	0	0.0	0	0.0
OP 26	0	0.0	0	0.0
OP 27	0	0.0	0	0.0

Birriwa Bus Route North

Receptor type: Route

No glare found

Birriwa Bus Route South - Cycle Trail

Receptor type: Route
No glare found

Castlereigh Hwy

Receptor type: Route
No glare found

Golden Hwy

Receptor type: Route
No glare found

Merotherie Rd

Receptor type: Route
No glare found

Railway

Receptor type: Route
No glare found

OP 1

Receptor type: Observation Point
No glare found

OP 2

Receptor type: Observation Point
No glare found

OP 3

Receptor type: Observation Point
No glare found

OP 4

Receptor type: Observation Point
No glare found

OP 5

Receptor type: Observation Point
No glare found

OP 6

Receptor type: Observation Point
No glare found

OP 7

Receptor type: Observation Point
No glare found

OP 8

Receptor type: Observation Point
No glare found

OP 9

Receptor type: Observation Point
No glare found

OP 10

Receptor type: Observation Point
No glare found

OP 11

Receptor type: Observation Point
No glare found

OP 12

Receptor type: Observation Point
No glare found

OP 13

Receptor type: Observation Point
No glare found

OP 14

Receptor type: Observation Point
No glare found

OP 15

Receptor type: Observation Point
No glare found

OP 16

Receptor type: Observation Point
No glare found

OP 17

Receptor type: Observation Point
No glare found

OP 18

Receptor type: Observation Point
No glare found

OP 19

Receptor type: Observation Point
No glare found

OP 20

Receptor type: Observation Point
No glare found

OP 21

Receptor type: Observation Point
No glare found

OP 22

Receptor type: Observation Point
No glare found

OP 23

Receptor type: Observation Point
No glare found

OP 24

Receptor type: Observation Point
No glare found

OP 25

Receptor type: Observation Point
No glare found

OP 26

Receptor type: Observation Point
No glare found

OP 27

Receptor type: Observation Point
No glare found

VS Face: 3-4 potential temporary after-image

Receptor results ordered by category of glare

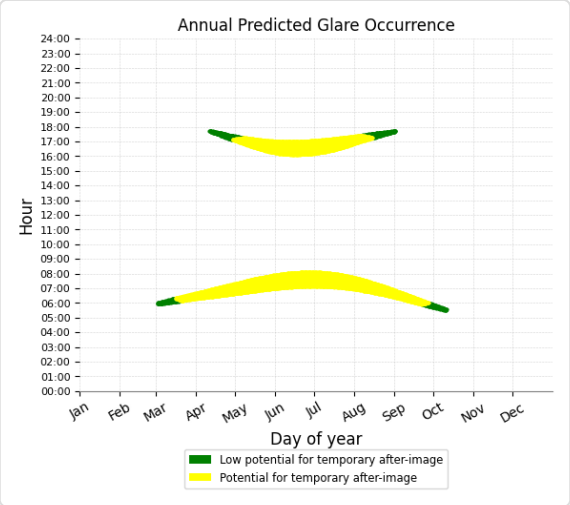
Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
Birriwa Bus Route South - Cycle Trail	825	13.8	12,115	201.9
Railway	97	1.6	0	0.0
Birriwa Bus Route North	0	0.0	0	0.0
Castlereigh Hwy	0	0.0	0	0.0
Golden Hwy	0	0.0	0	0.0
Merotherie Rd	0	0.0	0	0.0
OP 13	3	0.1	0	0.0
OP 14	6	0.1	0	0.0
OP 15	7	0.1	0	0.0
OP 16	7	0.1	0	0.0
OP 17	8	0.1	0	0.0
OP 18	10	0.2	0	0.0
OP 19	12	0.2	0	0.0
OP 1	0	0.0	0	0.0
OP 2	0	0.0	0	0.0
OP 3	0	0.0	0	0.0
OP 4	0	0.0	0	0.0
OP 5	0	0.0	0	0.0
OP 6	0	0.0	0	0.0
OP 7	0	0.0	0	0.0
OP 8	0	0.0	0	0.0
OP 9	0	0.0	0	0.0
OP 10	0	0.0	0	0.0
OP 11	0	0.0	0	0.0
OP 12	0	0.0	0	0.0
OP 20	0	0.0	0	0.0
OP 21	0	0.0	0	0.0
OP 22	0	0.0	0	0.0
OP 23	0	0.0	0	0.0
OP 24	0	0.0	0	0.0
OP 25	0	0.0	0	0.0
OP 26	0	0.0	0	0.0
OP 27	0	0.0	0	0.0

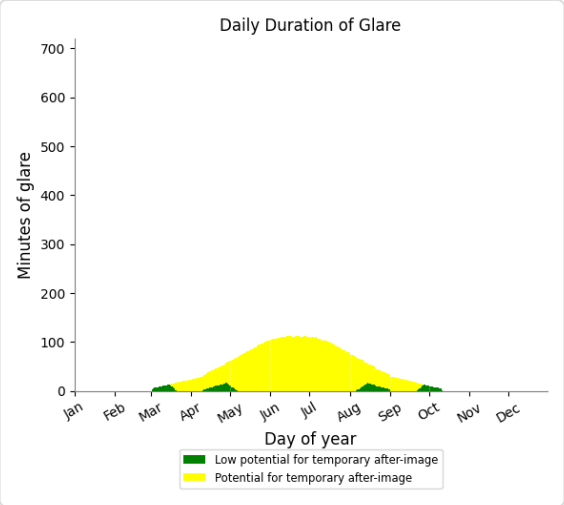
Birriwa Bus Route South - Cycle Trail

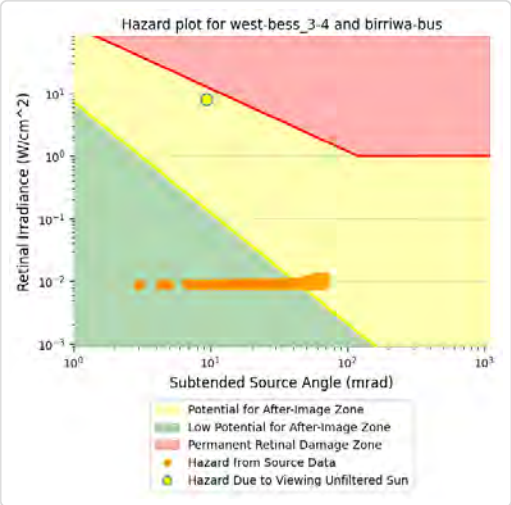
Receptor type: Route

12,115 minutes of yellow glare

825 minutes of green glare





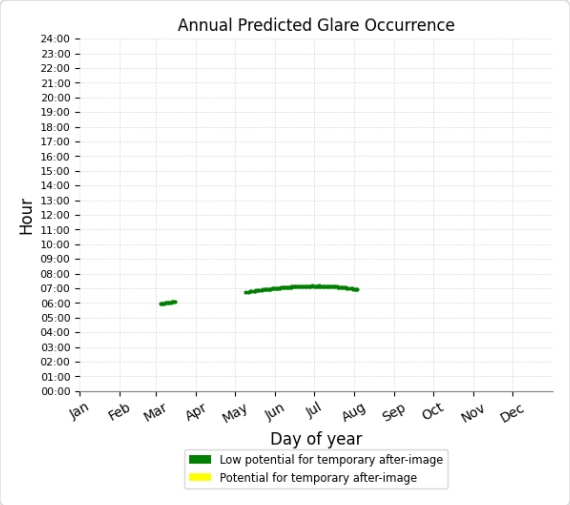


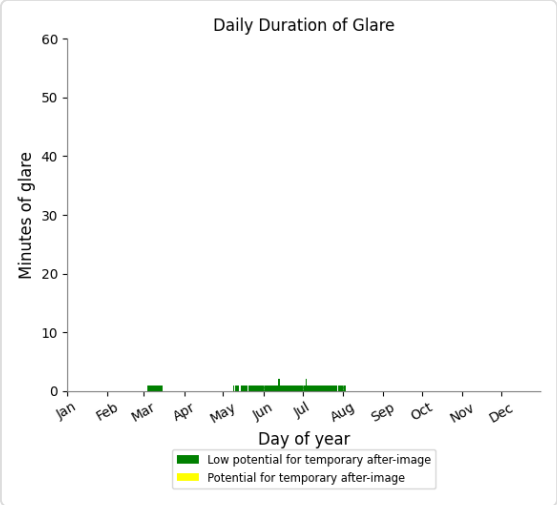
Railway

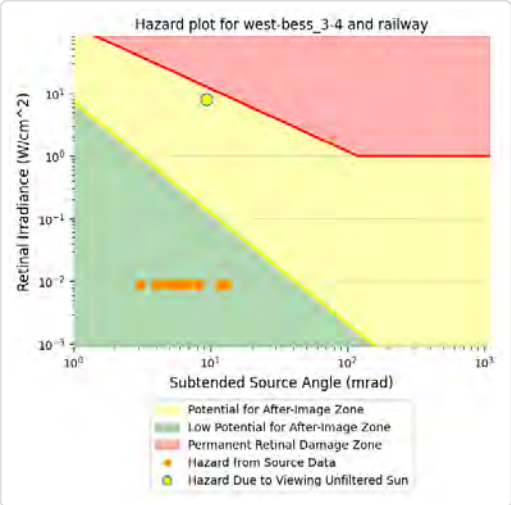
Receptor type: Route

0 minutes of yellow glare

97 minutes of green glare







Birriwa Bus Route North

Receptor type: Route

No glare found

Castlereigh Hwy

Receptor type: Route

No glare found

Golden Hwy

Receptor type: Route

No glare found

Merotherie Rd

Receptor type: Route

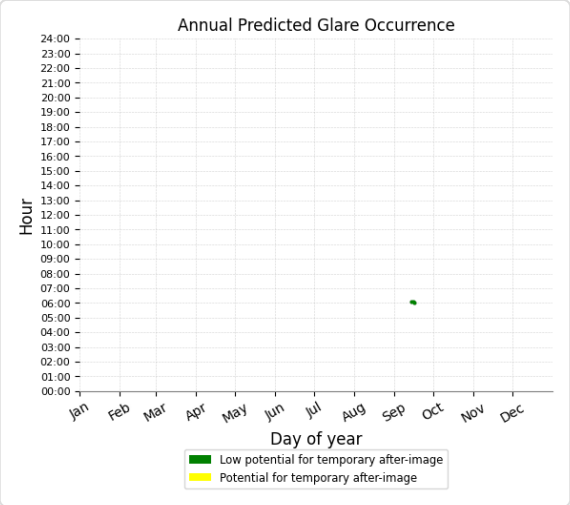
No glare found

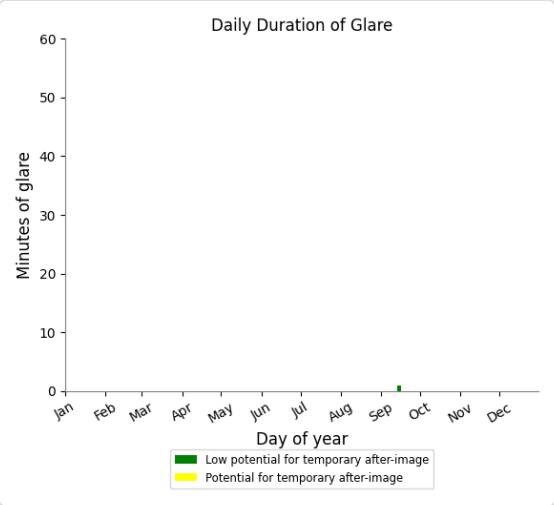
OP 13

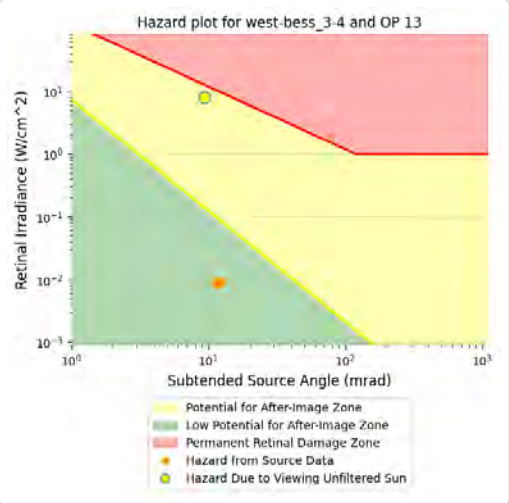
Receptor type: Observation Point

0 minutes of yellow glare

3 minutes of green glare





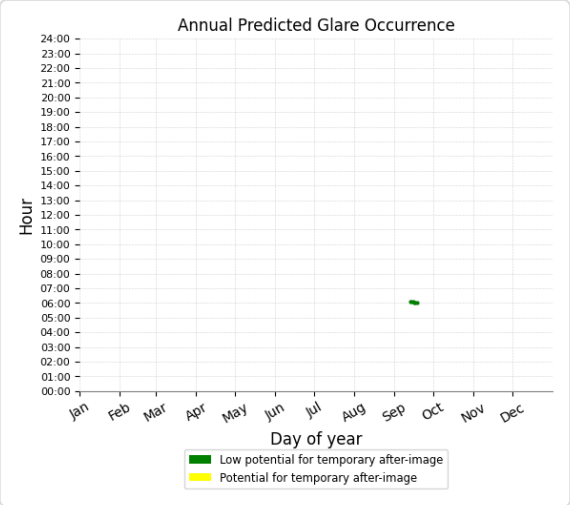


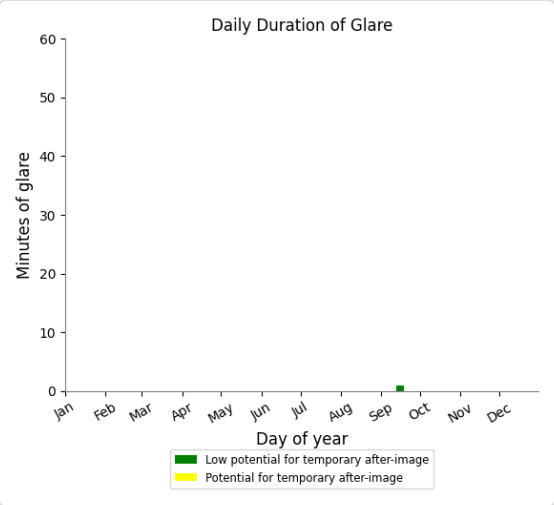
OP 14

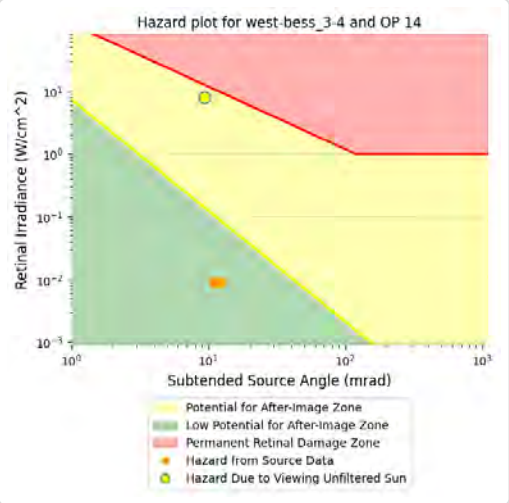
Receptor type: Observation Point

0 minutes of yellow glare

6 minutes of green glare





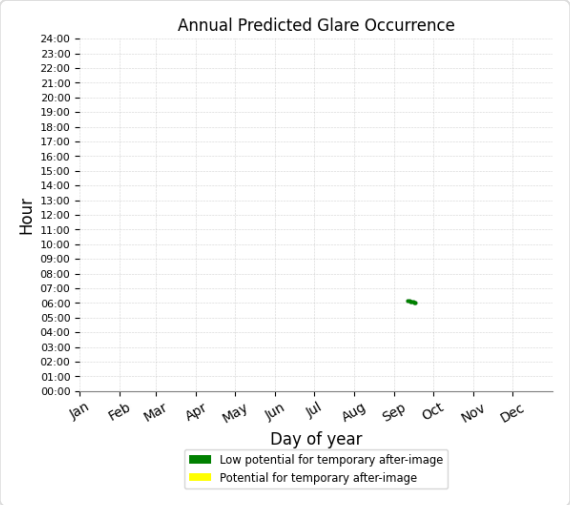


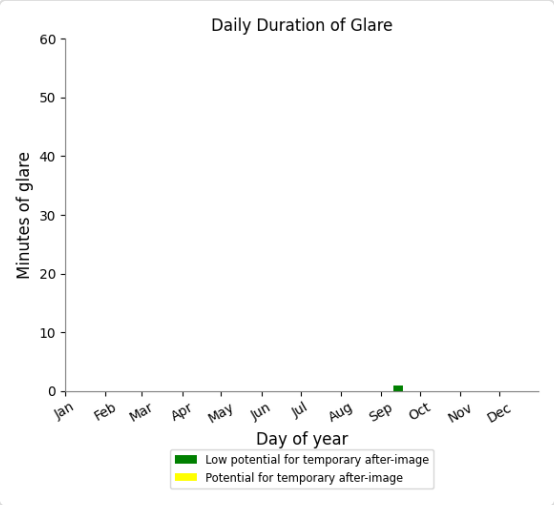
OP 15

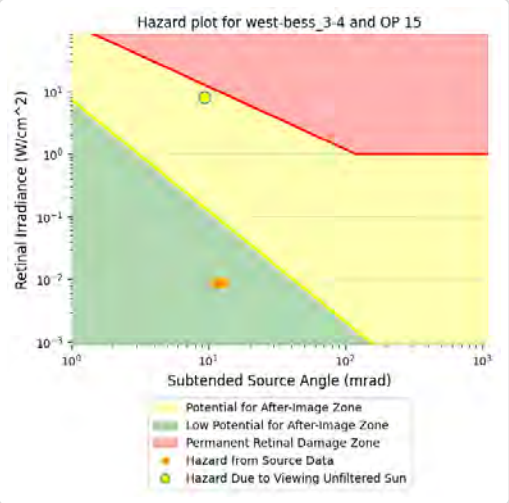
Receptor type: Observation Point

0 minutes of yellow glare

7 minutes of green glare





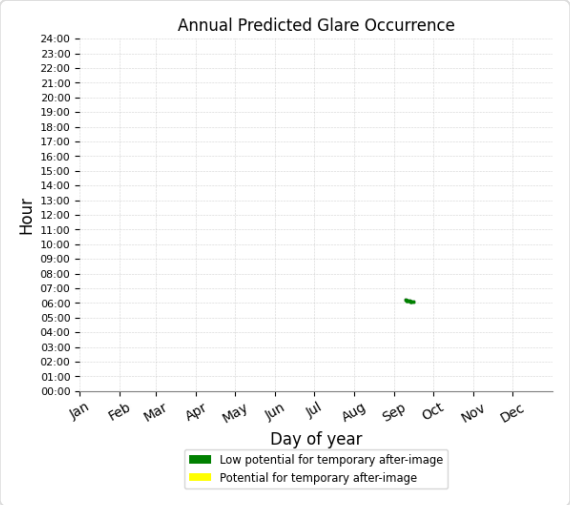


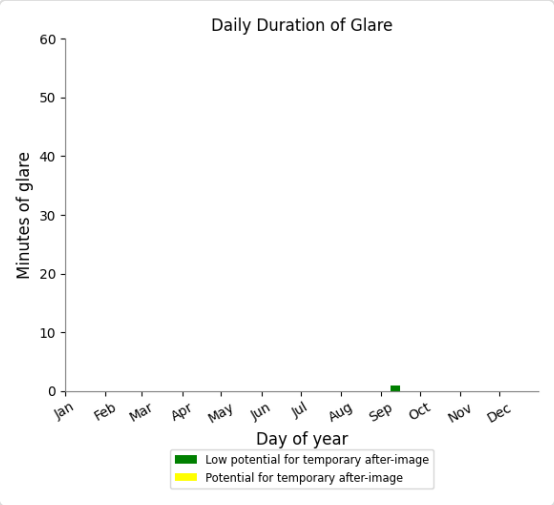
OP 16

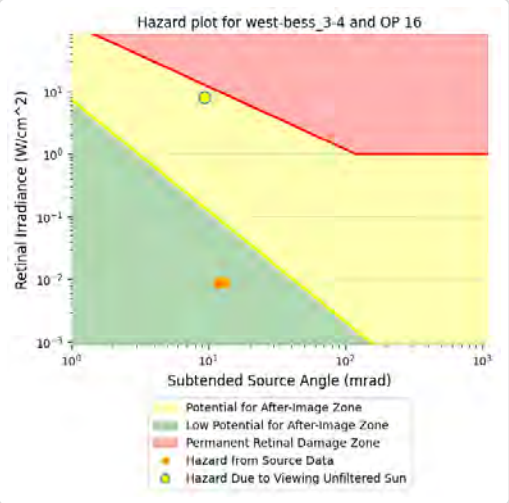
Receptor type: Observation Point

0 minutes of yellow glare

7 minutes of green glare





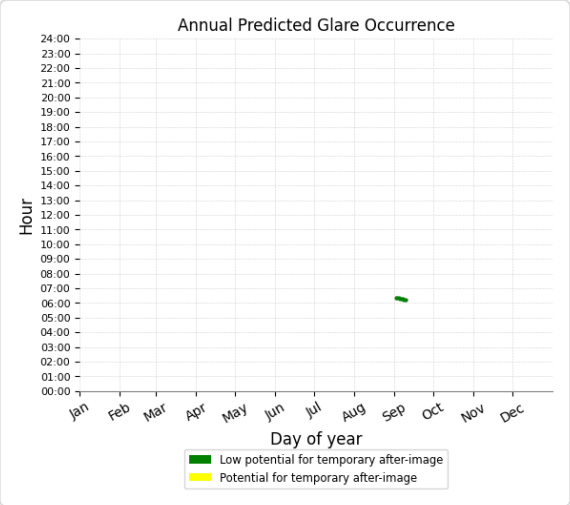


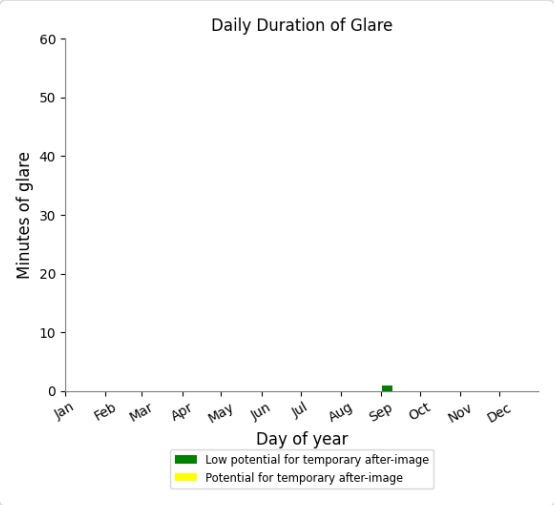
OP 17

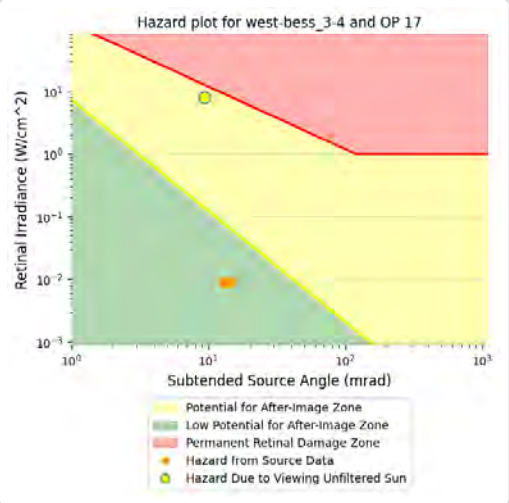
Receptor type: Observation Point

0 minutes of yellow glare

8 minutes of green glare

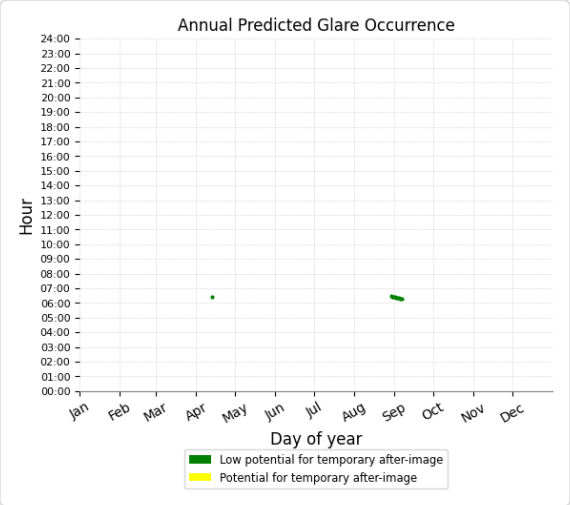


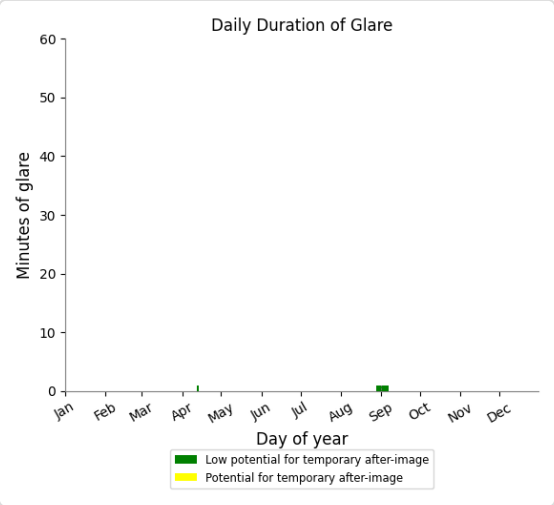


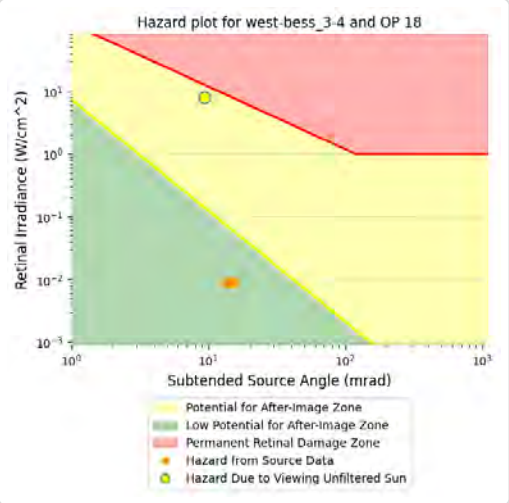


OP 18

Receptor type: Observation Point
0 minutes of yellow glare
10 minutes of green glare

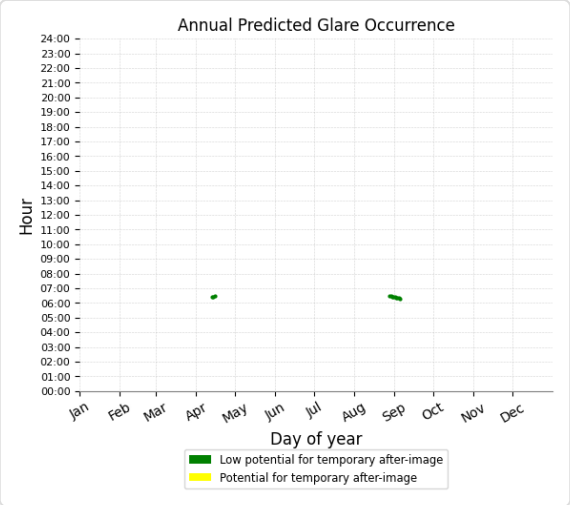


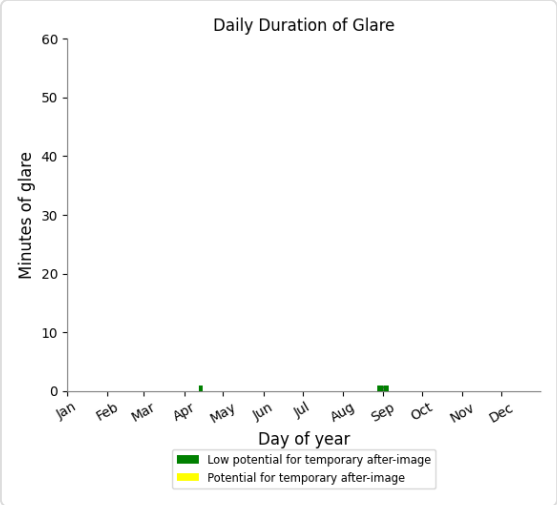


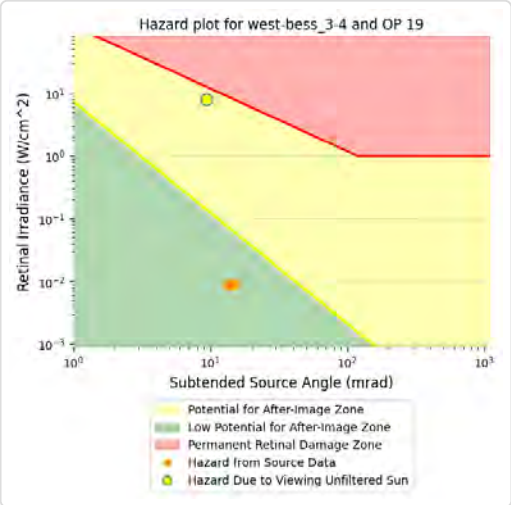


OP 19

Receptor type: Observation Point
0 minutes of yellow glare
12 minutes of green glare







OP 1

Receptor type: Observation Point
No glare found

OP 2

Receptor type: Observation Point
No glare found

OP 3

Receptor type: Observation Point
No glare found

OP 4

Receptor type: Observation Point
No glare found

OP 5

Receptor type: Observation Point
No glare found

OP 6

Receptor type: Observation Point
No glare found

OP 7

Receptor type: Observation Point
No glare found

OP 8

Receptor type: Observation Point
No glare found

OP 9

Receptor type: Observation Point
No glare found

OP 10

Receptor type: Observation Point
No glare found

OP 11

Receptor type: Observation Point
No glare found

OP 12

Receptor type: Observation Point
No glare found

OP 20

Receptor type: Observation Point
No glare found

OP 21

Receptor type: Observation Point
No glare found

OP 22

Receptor type: Observation Point
No glare found

OP 23

Receptor type: Observation Point
No glare found

OP 24

Receptor type: Observation Point
No glare found

OP 25

Receptor type: Observation Point
No glare found

OP 26

Receptor type: Observation Point
No glare found

OP 27

Receptor type: Observation Point
No glare found

VS Face: 4-5 potential temporary after-image

Receptor results ordered by category of glare

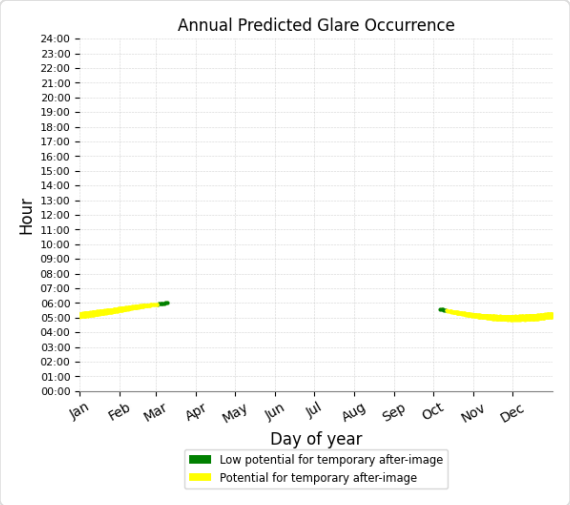
Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
Birriwa Bus Route South - Cycle Trail	13	0.2	1,203	20.1
Merotherie Rd	17	0.3	0	0.0
Birriwa Bus Route North	0	0.0	0	0.0
Castlereigh Hwy	0	0.0	0	0.0
Golden Hwy	0	0.0	0	0.0
Railway	0	0.0	0	0.0
OP 9	11	0.2	0	0.0
OP 1	0	0.0	0	0.0
OP 2	0	0.0	0	0.0
OP 3	0	0.0	0	0.0
OP 4	0	0.0	0	0.0
OP 5	0	0.0	0	0.0
OP 6	0	0.0	0	0.0
OP 7	0	0.0	0	0.0
OP 8	0	0.0	0	0.0
OP 10	0	0.0	0	0.0
OP 11	0	0.0	0	0.0
OP 12	0	0.0	0	0.0
OP 13	0	0.0	0	0.0
OP 14	0	0.0	0	0.0
OP 15	0	0.0	0	0.0
OP 16	0	0.0	0	0.0
OP 17	0	0.0	0	0.0
OP 18	0	0.0	0	0.0
OP 19	0	0.0	0	0.0
OP 20	0	0.0	0	0.0
OP 21	0	0.0	0	0.0
OP 22	0	0.0	0	0.0
OP 23	0	0.0	0	0.0
OP 24	0	0.0	0	0.0
OP 25	0	0.0	0	0.0
OP 26	0	0.0	0	0.0
OP 27	0	0.0	0	0.0

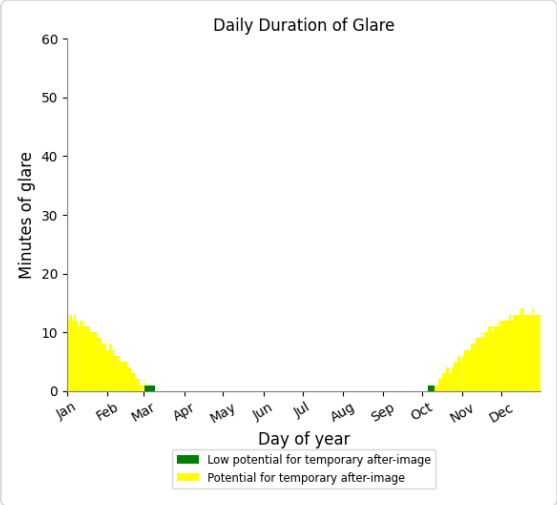
Birriwa Bus Route South - Cycle Trail

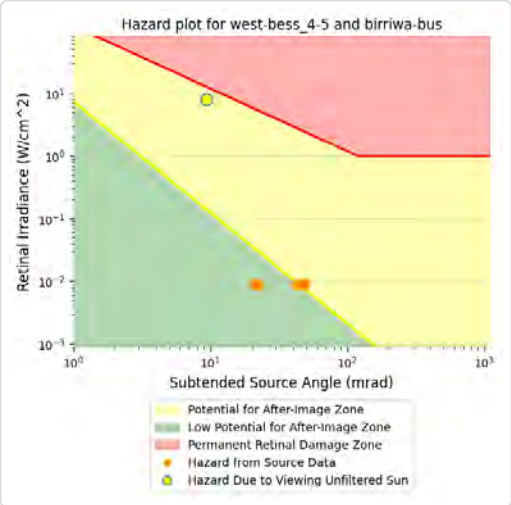
Receptor type: Route

1,203 minutes of yellow glare

13 minutes of green glare

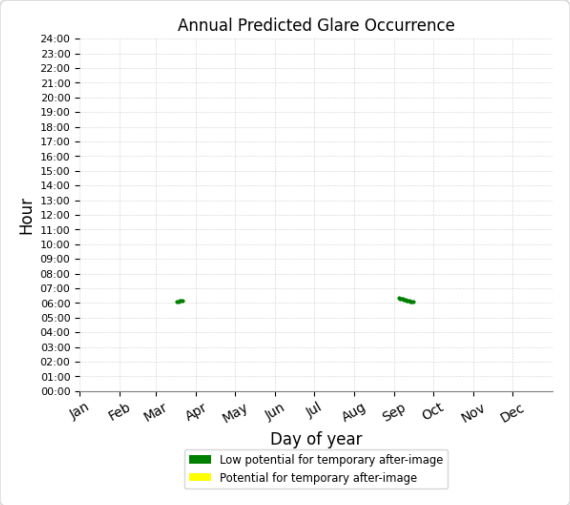


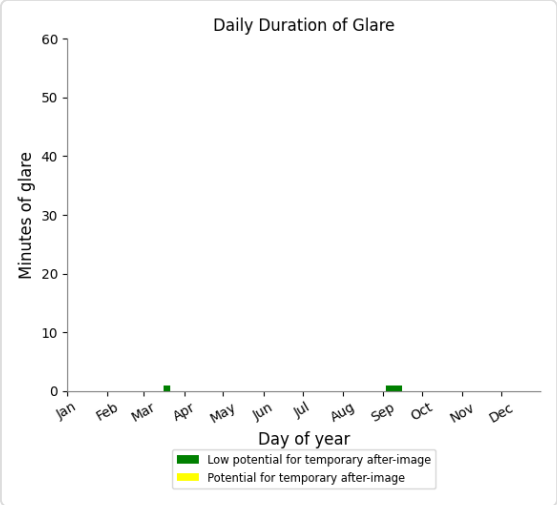


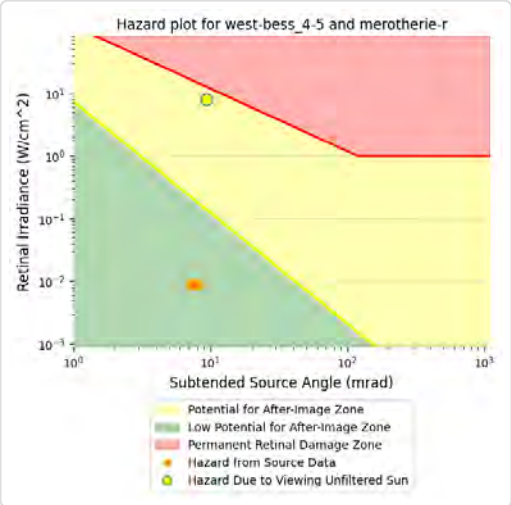


Merotherie Rd

Receptor type: Route
0 minutes of yellow glare
17 minutes of green glare







Birriwa Bus Route North

Receptor type: Route
No glare found

Castlereigh Hwy

Receptor type: Route
No glare found

Golden Hwy

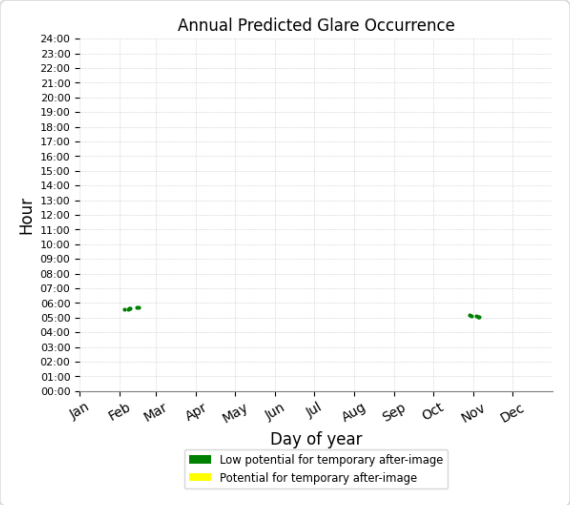
Receptor type: Route
No glare found

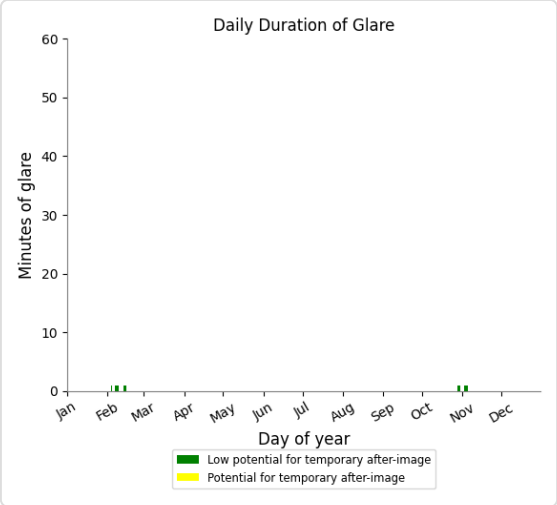
Railway

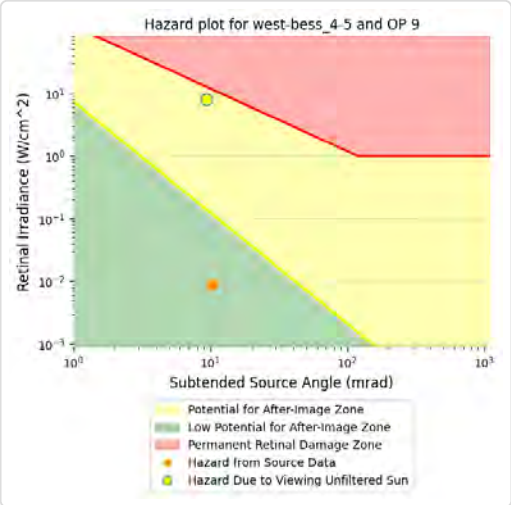
Receptor type: Route
No glare found

OP 9

Receptor type: Observation Point
0 minutes of yellow glare
11 minutes of green glare







OP 1

Receptor type: Observation Point
No glare found

OP 2

Receptor type: Observation Point
No glare found

OP 3

Receptor type: Observation Point
No glare found

OP 4

Receptor type: Observation Point
No glare found

OP 5

Receptor type: Observation Point
No glare found

OP 6

Receptor type: Observation Point
No glare found

OP 7

Receptor type: Observation Point
No glare found

OP 8

Receptor type: Observation Point
No glare found

OP 10

Receptor type: Observation Point
No glare found

OP 11

Receptor type: Observation Point
No glare found

OP 12

Receptor type: Observation Point
No glare found

OP 13

Receptor type: Observation Point
No glare found

OP 14

Receptor type: Observation Point
No glare found

OP 15

Receptor type: Observation Point
No glare found

OP 16

Receptor type: Observation Point
No glare found

OP 17

Receptor type: Observation Point
No glare found

OP 18

Receptor type: Observation Point
No glare found

OP 19

Receptor type: Observation Point
No glare found

OP 20

Receptor type: Observation Point
No glare found

OP 21

Receptor type: Observation Point
No glare found

OP 22

Receptor type: Observation Point
No glare found

OP 23

Receptor type: Observation Point
No glare found

OP 24

Receptor type: Observation Point
No glare found

OP 25

Receptor type: Observation Point
No glare found

OP 26

Receptor type: Observation Point
No glare found

OP 27

Receptor type: Observation Point
No glare found

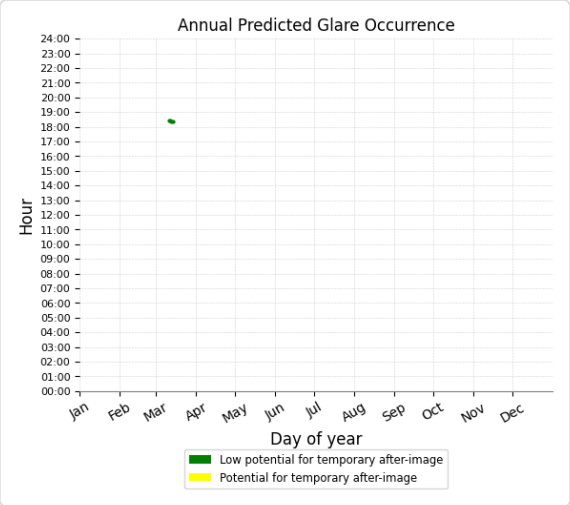
VS Face: 5-6 low potential for temporary after-image

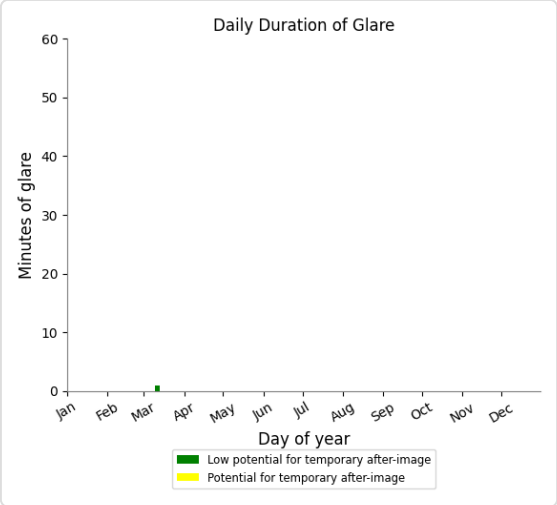
Receptor results ordered by category of glare

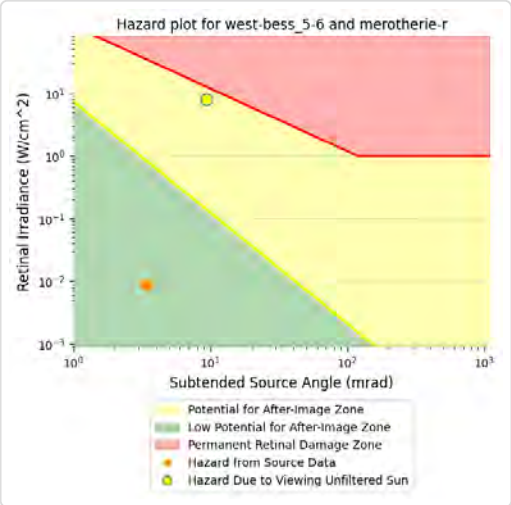
Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
Merotherie Rd	4	0.1	0	0.0
Birriwa Bus Route North	0	0.0	0	0.0
Birriwa Bus Route South - Cycle Trail	0	0.0	0	0.0
Castlereigh Hwy	0	0.0	0	0.0
Golden Hwy	0	0.0	0	0.0
Railway	0	0.0	0	0.0
OP 1	0	0.0	0	0.0
OP 2	0	0.0	0	0.0
OP 3	0	0.0	0	0.0
OP 4	0	0.0	0	0.0
OP 5	0	0.0	0	0.0
OP 6	0	0.0	0	0.0
OP 7	0	0.0	0	0.0
OP 8	0	0.0	0	0.0
OP 9	0	0.0	0	0.0
OP 10	0	0.0	0	0.0
OP 11	0	0.0	0	0.0
OP 12	0	0.0	0	0.0
OP 13	0	0.0	0	0.0
OP 14	0	0.0	0	0.0
OP 15	0	0.0	0	0.0
OP 16	0	0.0	0	0.0
OP 17	0	0.0	0	0.0
OP 18	0	0.0	0	0.0
OP 19	0	0.0	0	0.0
OP 20	0	0.0	0	0.0
OP 21	0	0.0	0	0.0
OP 22	0	0.0	0	0.0
OP 23	0	0.0	0	0.0
OP 24	0	0.0	0	0.0
OP 25	0	0.0	0	0.0
OP 26	0	0.0	0	0.0
OP 27	0	0.0	0	0.0

Merotherie Rd

Receptor type: Route
0 minutes of yellow glare
4 minutes of green glare







Birriwa Bus Route North

Receptor type: Route
No glare found

Birriwa Bus Route South - Cycle Trail

Receptor type: Route
No glare found

Castlereigh Hwy

Receptor type: Route
No glare found

Golden Hwy

Receptor type: Route
No glare found

Railway

Receptor type: Route
No glare found

OP 1

Receptor type: Observation Point
No glare found

OP 2

Receptor type: Observation Point
No glare found

OP 3

Receptor type: Observation Point
No glare found

OP 4

Receptor type: Observation Point
No glare found

OP 5

Receptor type: Observation Point
No glare found

OP 6

Receptor type: Observation Point
No glare found

OP 7

Receptor type: Observation Point
No glare found

OP 8

Receptor type: Observation Point
No glare found

OP 9

Receptor type: Observation Point
No glare found

OP 10

Receptor type: Observation Point
No glare found

OP 11

Receptor type: Observation Point
No glare found

OP 12

Receptor type: Observation Point
No glare found

OP 13

Receptor type: Observation Point
No glare found

OP 14

Receptor type: Observation Point
No glare found

OP 15

Receptor type: Observation Point
No glare found

OP 16

Receptor type: Observation Point
No glare found

OP 17

Receptor type: Observation Point
No glare found

OP 18

Receptor type: Observation Point
No glare found

OP 19

Receptor type: Observation Point
No glare found

OP 20

Receptor type: Observation Point
No glare found

OP 21

Receptor type: Observation Point

No glare found

OP 22

Receptor type: Observation Point

No glare found

OP 23

Receptor type: Observation Point

No glare found

OP 24

Receptor type: Observation Point

No glare found

OP 25

Receptor type: Observation Point

No glare found

OP 26

Receptor type: Observation Point

No glare found

OP 27

Receptor type: Observation Point

No glare found

Assumptions

"Green" glare is glare with low potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
"Yellow" glare is glare with potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
Times associated with glare are denoted in Standard time. For Daylight Savings, add one hour.
The algorithm does not rigorously represent the detailed geometry of a system; detailed features such as gaps between modules, variable height of the PV array, and support structures may impact actual glare results. However, we have validated our models against several systems, including a PV array causing glare to the air-traffic control tower at Manchester-Boston Regional Airport and several sites in Albuquerque, and the tool accurately predicted the occurrence and intensity of glare at different times and days of the year.
Several V1 calculations utilize the PV array centroid, rather than the actual glare spot location, due to algorithm limitations. This may affect results for large PV footprints. Additional analyses of array sub-sections can provide additional information on expected glare. This primarily affects V1 analyses of path receptors.
Random number computations are utilized by various steps of the annual hazard analysis algorithm. Predicted minutes of glare can vary between runs as a result. This limitation primarily affects analyses of Observation Point receptors, including ATCTs. Note that the SGHAT/ ForgeSolar methodology has always relied on an analytical, qualitative approach to accurately determine the overall hazard (i.e. green vs. yellow) of expected glare on an annual basis.
The analysis does not consider obstacles (either man-made or natural) between the observation points and the prescribed solar installation that may obstruct observed glare, such as trees, hills, buildings, etc.
The subtended source angle (glare spot size) is constrained by the PV array footprint size. Partitioning large arrays into smaller sections will reduce the maximum potential subtended angle, potentially impacting results if actual glare spots are larger than the sub-array size. Additional analyses of the combined area of adjacent sub-arrays can provide more information on potential glare hazards. (See previous point on related limitations.)
The variable direct normal irradiance (DNI) feature (if selected) scales the user-prescribed peak DNI using a typical clear-day irradiance profile. This profile has a lower DNI in the mornings and evenings and a maximum at solar noon. The scaling uses a clear-day irradiance profile based on a normalized time relative to sunrise, solar noon, and sunset, which are prescribed by a sun-position algorithm and the latitude and longitude obtained from Google maps. The actual DNI on any given day can be affected by cloud cover, atmospheric attenuation, and other environmental factors.
The ocular hazard predicted by the tool depends on a number of environmental, optical, and human factors, which can be uncertain. We provide input fields and typical ranges of values for these factors so that the user can vary these parameters to see if they have an impact on the results. The speed of SGHAT allows expedited sensitivity and parametric analyses.
The system output calculation is a DNI-based approximation that assumes clear, sunny skies year-round. It should not be used in place of more rigorous modeling methods.
Hazard zone boundaries shown in the Glare Hazard plot are an approximation and visual aid based on aggregated research data. Actual ocular impact outcomes encompass a continuous, not discrete, spectrum.
Glare locations displayed on receptor plots are approximate. Actual glare-spot locations may differ.
Refer to the Help page at **www.forgesolar.com/help/** for assumptions and limitations not listed here.

Default glare analysis parameters and observer eye characteristics (for reference only):

- Analysis time interval: 1 minute
- Ocular transmission coefficient: 0.5
- Pupil diameter: 0.002 meters
- Eye focal length: 0.017 meters
- Sun subtended angle: 9.3 milliradians

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